

# TRANSPORTATION PROJECT REPORT

## DRAFT DESIGN REPORT / DRAFT ENVIRONMENTAL IMPACT STATEMENT / DRAFT 4(f) EVALUATION

### APPENDIX B4

#### Floodplain Evaluation Report

November 2016

PIN 5470.22

NYS Route 198 (Scajaquada Expressway Corridor)  
Grant Street Interchange to Parkside Avenue Intersection  
City of Buffalo  
Erie County



ANDREW M. CUOMO  
Governor

Department of  
Transportation

MATTHEW J. DRISCOLL  
Commissioner



U.S. Department of Transportation  
Federal Highway Administration

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## **1.0 INTRODUCTION**

The following Floodplain Evaluation Report has been prepared by Bergmann Associates, P.C. (Bergmann) for the Reconstruction of NYS Route 198, from the Grant Street interchange to the Parkside Avenue intersection within the City of Buffalo, Erie County, New York (PIN 5470.22). This report was prepared for the New York State Department of Transportation (NYSDOT) under contract D015557 in technical support of the proposed roadway reconstruction project. See Figures 1 and 2 in Attachment A for the Project Location Map and Project Location Map: Corridor Extents. A Surface Waters Map (Exhibit 4.4.2-1) is also provided in Appendix B1. Please refer to Sections 1.1 and 1.2 of the Design Report / Environmental Impact Statement for more information regarding the project description, and refer to Section 3.2 of the Design Report / Environmental Impact Statement for more information regarding the project build alternative.

### **1.1 Scope and Purpose**

The purpose of this floodplain evaluation study is to document the existing floodplains within the study area, to evaluate potential floodplain and floodway encroachments and potential effects on natural and beneficial floodplain values of the Build Alternative and to assure that the project complies with all applicable provisions of State and Federal floodplain requirements. The study area includes Scajaquada Creek, which is a regulated floodplain in the National Flood Insurance Program (NFIP).

### **1.2 State and Federal Regulations**

This floodplain evaluation must comply with the provisions of Executive Order (EO) 11988, Flood Plain Management, as amended by EO 13690, including the Federal Flood Risk Management Standard (FFRMS) established. The facilities and structures associated with the project must also be designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (NFIP) contained in 44 CFR Part 60. The federal requirements pertaining to floodplains are implemented in 23 CFR 650 Subpart A, Location and Hydraulic Design of Encroachments on Floodplains. New York State requirements include 6 NYCRR 502, Flood Plain Management Criteria for State Projects. Together, these regulations are applied to determine potential impacts on NFIP floodplains within the study area to assure that the project is consistent with all applicable provisions of the State and Federal floodplain requirements.

EO 13690 and the FFRMS have been developed to create a national minimum flood risk management standard to ensure that Federal Actions that are located in or near the floodplain when there are no other practical alternatives, last as long as intended by considering risks, changes in climate, and vulnerability. The FFRMS alters the implementation of EO 11988 through the following enhancements:

1. The FFRMS encourages the use of natural features and nature-based approaches in the development of alternatives for Federal Actions;
2. The FFRMS provides a higher vertical elevation and corresponding horizontal floodplain, where appropriate, to address current and future flood risks;
3. The vertical flood horizontal elevation and corresponding floodplain for federally funded projects must, at a minimum, use one of the following approaches to determine the vertical flood elevation of the FFRMS using one of three approaches;
  - a. Climate-informed Science Approach (CISA) – use the best available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science,

- b. *Freeboard Value Approach (FVA)* – use the Base Flood Elevation (or 1-percent annual chance flood determined using best available data) and an additional height to calculate the freeboard value. The additional height will depend on whether or not the action is a Critical Action.
- c. The 0.2-percent-annual-chance Flood Approach (0.2PFA) – use the 0.2-percent annual-chance flood elevation (also known as the 500-year flood elevation).
- d. Use any other method identified in an update to the FFRMS.

The modifications to existing bridges, bridge removals, proposed bridges and changes to the roadway plan and profile are considered potential transverse and lateral encroachments. The design of lateral encroachments and waterway crossings must comply with the aforementioned regulations.

EO 11988, (amended January 2015), requires each Federal agency, in carrying out its activities, to take action to reduce the risk of flood loss, minimize the impacts of floods, restore and preserve the natural and beneficial values served by floodplains, and evaluate the potential effects of any actions it may take in the floodplain so as to ensure its planning programs reflect considerations of flood hazards and floodplain management. 23 CFR 650 Subpart A, states that it is the policy of FHWA to encourage a broad and unified effort to:

- prevent uneconomic, hazardous or incompatible use and development of the Nation's floodplains;
- avoid longitudinal encroachments where practicable;
- avoid significant encroachments, where practicable;
- minimize impacts of highway agency actions which adversely affect base floodplains;
- restore and preserve the natural and beneficial floodplain values that are adversely impacted by highway agency actions;
- avoid support of incompatible floodplain development;
- be consistent with the intent of the standards and criteria of the National Flood Insurance Program, where appropriate; and
- incorporate "A Unified National Program for Floodplain Management" of the Water Resources Council into FHWA procedures.

One aspect of the FFRMS is the definition of a Critical Action, which is defined in the regulation to "include any activity for which even a slight chance of flooding is too great." The concept of Critical Action reflects a concern that the impacts of flooding on human safety, health, and welfare for many activities could not be minimized unless a higher degree of protection or resilience than that delivered by the Base Flood Elevation was provided. When determining whether a Federal Action constitutes a Critical Action, questions such as the following arise:

- If flooded, would the proposed action create an added dimension to the disaster, as could be the case for liquefied natural gas terminals and facilities producing and storing highly volatile, toxic, or water-reactive materials?
- Given the flood warning lead-time available, would the occupants of buildings such as hospitals, nursing homes, prisons, and schools be sufficiently mobile to avoid loss of life and injury?
- Would essential and irreplaceable records, scientific and cultural museum collections, utilities, emergency services, national laboratories, and structures that may house critical equipment, systems, networks, and functions be lost?

The study area is limited to the transportation corridor, which is a boulevard within the City of Buffalo, but not necessary as the sole traffic route in evacuation or for essential vehicles. The surrounding buildings and neighborhoods are all linked to other traffic routes that could be used in the event of a flood. Additionally, as the existing roadway corridor is already located in the floodplain and the



proposed project design will reduce the frequency of roadway flooding, the project is judged to not be a Critical Action.

The State's 6 NYCRR Part 502 regulations are implemented to ensure that the use of State owned lands and the siting, construction, administration and disposition of State-owned and State-financed facilities are conducted in ways that will minimize flood hazards and losses. NYCRR 502.4(b)(5) states "No portion of the project including encroachments, fill, new construction or substantial improvements shall be placed within the regulatory floodway that would result in any increase in flood levels during the occurrence of the base flood discharge, except where the effects of flood levels, due to the lack of floodway capacity is completely offset by the creation of equal flooding hydraulic capacity at that point." To assess this, a HEC-RAS model was developed, using hydraulic cross sections and other topographic surveys obtained as part of the project.

The facilities and structures associated with the project must also be designed to be consistent with the intent of the standards and criteria of the following requirements of the NFIP (44 CFR Part 60). To comply with the intent of these regulations, all new construction and substantial improvements will:

- Be designed or modified and adequately anchored to prevent floatation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy [44 CFR Part 60.3(a) (3) (i)];
- Be constructed with materials resistant to flood damage [44CFR Part 60.3(a) (3) (ii)];
- Be constructed by methods and practices that minimize flood damages [44 CFR Part 60.3 (a) (3) (iv)];
- Be constructed with electrical and other services facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding [44 CFR Part 60.3 (a) (3) (iv)]; and
- Prohibit encroachments, including fill, new construction, substantial improvements and other development within the adopted regulatory floodway [44 CFR Part 60.3 (d) (3).

## **2.0 BACKGROUND INFORMATION**

The effective FEMA Flood Insurance Study (FIS) 1% annual chance floodplain boundaries for the study area include Scajaquada Creek as determined from the FEMA Flood Insurance Rate Map (FIRM), Erie County, New York (All Jurisdictions), September 26, 2008. Scajaquada Creek is located within the project limits in the City of Buffalo. The effective FEMA Flood Insurance Study delineates Scajaquada Creek as a Zone-AE with a floodway. Additionally, there are multiple Zone-X areas in the vicinity of the NYS Route 198; however, these areas are not regulatory, meaning that proposed development in Zone X areas does not require further coordination with FEMA. The effective FIS study products are presented in Attachment B. There are no additional delineated floodplains within the study area.

A preliminary FIS and FIRMs are available for Erie County and provided in Attachment C; however, these are not yet regulatory. The Scajaquada Creek project corridor is delineated on map numbers 36029C0211H, 36029C0192H, and 36029C0184H with a preliminary date of December 31, 2009. The preliminary FIS and FIRMs show an increase in peak discharges of approximately 30% above the effective discharges and increases in the Base Flood Elevations throughout the study area. Since the preliminary FIS and FIRM are not yet approved for regulatory use, they were reviewed for informational purposes, but were not used for the determination of meeting regulatory requirements. Instead, the effective 1% annual chance FEMA discharge of 4,700 cubic feet per second was used during the natural conditions and floodway runs with proposed bridge conditions.

### 3.0 PRELIMINARY ANALYSES OF PROJECT EFFECTS

The project involves the replacement or modifications to thirteen bridges within the project corridor. The bridges over water that involve development within the floodplain and floodway are:

- The two bridges carrying the existing Grant Street ramps over Scajaquada Creek (BINs 1039930 and 1039940) would be removed and replaced with a single bridge for the Grant Street connector.
- The Elmwood Avenue Ramp EC connector bridge over Scajaquada Creek (BIN 1039959) would be replaced in the same location. The bridge length would be slightly longer; however, the bridge would be widened to accommodate the multiple lanes of traffic carried.
- Elmwood Avenue Ramp EK (BIN 1039970), just east of Elmwood Avenue, would be removed and a new pedestrian bridge over Scajaquada Creek, just west of Mirror Lake would be constructed nearby.
- A new pedestrian bridge would be constructed between Elmwood and Grant Street over Scajaquada Creek near Buffalo State.

The remainder of the bridge work is limited to deck and superstructure work that would not affect the hydraulic opening of the bridges.

#### 3.1 Compliance with Federal Flood Risk Management Standard

Typically, NYSDOT procedure is to review both the FEMA effective/proposed discharges and the United States Geological Service (USGS) Stream Stats discharges based on regional regression equations. According to USGS Stream Stats, the watershed is currently approximately 95% developed and 44% impervious, which is outside the appropriate usage of regional regression equation analysis alone; as a result, the regression equation discharges were not pursued. A review was conducted of the discharges reported in the effective (September 26, 2008) and preliminary (December 31, 2009) FEMA Flood Insurance Studies (FIS) for Erie County, the discharges developed by NYSDOT for the Elmwood Avenue Bridge Replacement, and a 1994 Bridge Scour Evaluation Study prepared by Bergmann Associates for the New York State Thruway Authority (NYSTA) I-190 bridge over Scajaquada Creek near the mouth. The I-190 study adjusted the discharges from the WRI 79-83 regional regression equation discharges using the urbanization adjustment provided in WRI 84-4350.

The effective FEMA discharges were derived from a Log Pearson Type III analysis of the Pine Ridge gage (USGS No. 04216200), located just upstream of the large underground tunnel that carries Scajaquada Creek below much of Buffalo. The gage was in operation between 1957 and 1994. During this time, the gage recorded peak discharges in excess of 2,000 cubic feet per second three times. The average annual peak discharge over the lifetime of the gage was approximately 1,000 cubic feet per second. The drainage area at the gage is 15.4 square miles, whereas the drainage area near the end of the project corridor is over 26 square miles. Although the tunnel itself may be adequately sized to convey the FEMA effective discharges, the urban stormwater systems connected to the tunnel may be providing restrictions so that stormwater runoff is stored on the streets and in the stormwater systems, then gradually released to the tunnel resulting in reduced peak discharges exiting the tunnel. An independent review of the gage data, Log Pearson III analysis, and an extrapolation of the data to the larger project drainage area, shows that the FEMA effective discharges, although high, are not out of the realm of reasonableness, based on the available hydrologic information. The history of known flooding through this reach of the Scajaquada corridor has not been as noteworthy; however, without another source of reputable information to determine appropriate discharges, the FEMA effective discharges remain the most appropriate for use.

The table below shows the discharges from the FISs, the effective FEMA FIS discharges (which were also used for the NYSDOT Elmwood Avenue bridge replacement project) and the NYSTA I-190 discharges developed by Bergmann Associates in 1994.

<b>Exhibit 3-1</b>			
<b>Discharges at Mouth of Scajaquada Creek - 28.4 square miles</b>			
<b>Return Interval</b>	<b>FEMA Effective (cubic feet per second)</b>	<b>FEMA Preliminary (cubic feet per second)</b>	<b>NYSTA I-190 Bridge Scour (cubic feet per second)</b>
10	2,900	4,250	3,780
50	4,100	5,330	5,520
100	4,700	6,100	6,690
500	6,200	6,950	8,700

Consideration of climate change is required by Executive Order 13690, the Federal Flood Risk Management Standard (FFRMS), and NY State's Community Risk and Resiliency Act. Furthermore, the NYS Flood Risk Management Standard is under development as are updates to the 6 NYCRR Part 502 regulations.

As stated in Section 1.0, the project is not considered a Critical Action. As such, the requirements are to design to conditions taking into account climate change conditions using one of the appropriate methods. Currently, the Climate Informed Science Approach uses information from the USGS Future Flow Explorer, which provides discharge analyses based on climate science. These discharges are originally based on the regional regression equations, which, as stated previously, are inappropriate for use in this watershed and produce discharges significantly less than the FEMA effective discharges. The Freeboard Value Approach and 0.2 Percent Annual Chance Flood Freeboard Approach are both primarily used for freeboard requirements for building or structure elevations and not appropriate for bridge design.

Due to lack of better information, for the preliminary analysis, the Design (Q50) and Base Flood (Q100) discharges used to analyze the replacement bridges will be the FEMA effective discharges. The discharges already appear to be higher and would produce levels of flooding greater than what has been experienced in the study area, but cannot be verified or discredited. Therefore, it was assumed that the discharges could be representative of a future climate change scenario and no additional increase due to climate change was included in this analysis.

The hydraulic analysis, discussed in the subsequent section demonstrates that using the effective FEMA FIS discharges, both the natural conditions floodplain and floodway hydraulic profiles, will be lower as a result of the project. The result has the same effect as designing the project with higher peak discharges.

### **3.2 Floodplain and Floodway Encroachment**

As described in Section 2.0, the project is required to be in compliance with the requirements of the National Flood Insurance Program (NFIP) and NYCRR Part 502. As such, development within delineated floodplains must not raise the Base Flood Elevations (BFE) by more than 1.0 feet.

Additionally, development within a delineated floodway, considered an encroachment, must not increase the floodway elevations more than 0.0 feet.

As currently profiled, three of the four bridges are considered an encroachment because either their deck and/or abutments are located within the existing floodway. Only the Elmwood Connector is not considered an encroachment. Exhibit 3.2 summarizes the encroachments for the two replacement highway bridges and the two new pedestrian bridges.

A detailed hydraulic analysis was performed, that included the entire reach of Scajaquada Creek within the project limits to show compliance with the floodplain and floodway requirements. The analysis showed that the combination of removal of Grant Street Connectors Ramp GF and GE (BIN 1039930 and BIN 1039940) for which the existing bridges are very hydraulically limiting, the removal of Elmwood Ramp EK (BIN 1039970), the addition of the replacement Grant Street Connector, replacement of the Elmwood Avenue connector and the addition of the two new pedestrian bridges would result in a slight decrease at all points on the 1% annual chance flood profile within the project limits. The floodway analysis, using the 1% annual chance flood, with the proposed conditions also showed a slight decrease at all points on the profile. Together these analyses assure that the project would be in compliance with the NFIP and NYCRR Part 502 and that no significant encroachment exists. Pertinent results from the HEC-RAS analyses are presented in Attachment D.

<b>Exhibit 3.2</b>					
<b>Summary of Proposed Bridge Compliance with Floodplain and Floodway Requirements</b>					
<b>Proposed Bridge</b>	<b>Description</b>	<b>Bridge Type</b>	<b>Abutments or Deck in Floodway?</b>	<b>BFE Rise</b>	<b>Floodway 100-Yr Rise</b>
Grant Street Connector	Single girder bridge, no pier, spanning waterway and pathway along right bank, low chord similar to existing	Replacement	Deck	<1.0 ft	<0.0 ft
Buffalo State Shared-Use Path Bridge	Single span truss bridge that spans floodway, at grade, connecting NYS Route 198 to pathway on right bank	New	Deck	<1.0 ft	<0.0 ft
Elmwood Avenue Connector	Single span girder with abutments set outside of original abutments, low chord similar to existing, wider to accommodate travel lanes	Replacement	N	<1.0 ft	<0.0 ft
Mirror Lake Shared-Use Path Bridge	Single span truss bridge spanning floodway and connecting NYS Route 198 to path on right bank	New	Deck/Abutment	<1.0 ft	<0.0 ft

A preliminary assessment of the total net quantity of fill that would be placed in the floodplain for the Build Alternative (including all roadways, pathways and bridges) was performed by calculating cut and fill quantities of construction stages 2 and 3 which are predominantly located within the floodplain of the effective FIS. This assessment showed that the net quantity of fill that would be added to the floodplain is approximately 6,000 cubic yards. Although this represents a decrease in

floodplain storage, the encroachment is minor, as evidenced by the 1% annual chance natural conditions and floodway runs, and thus is not expected to result in significant impacts on natural and beneficial floodplain values, as required by NYCRR Part 502.

### **3.3 Risk Analysis**

NYSDOT has assumed providing two feet of freeboard for the 50-year event as the desired level of risk for this level of highway. Based on the preliminary design of the four bridges over water in the project corridor and the effective FEMA water surface profiles, emergency vehicles would be able to maintain access across both vehicular bridges (Grant Street Connector and Elmwood Connector) during the 50-year event. The Elmwood Connector meets the freeboard requirement for the 50-year event; however, the Grant Street Connector does not, and the NYS Route 198 intersection would be overtopped; however, by less than for the existing conditions. The Grant Street Connector is anticipated to be longer, have a slightly higher deck and low chord, and a narrower than the two bridges it is replacing, and would have a larger bridge opening that would reduce the risk of overtopping from existing conditions.

Portions of the proposed mainline section of NYS 198 would also be overtopped by the FEMA effective 1% annual chance flood event, however, this condition would remain the same from existing to proposed, with a slight decrease in flooding due under the proposed conditions. Additionally, NYS Route 198, which is proposed to be classified as a boulevard, is not the only accessible roadway in the area. The surrounding neighborhoods are linked through other networks of streets and therefore interruption of traffic flow due to flooding would not create a terminus to travel. Based on this, the proposed project improvements do not pose an increase to risk or interruption to emergency access. Neither NYCRR Part 502 nor the NFIP regulate the appropriate level of flooding for roadways. Since the level of flooding for the study area is reduced by the proposed action, it is assumed that the level of risk is acceptable. Pertinent results from the HEC-RAS analyses are presented in Attachment D.

### **3.4 Coordination with FEMA**

FHWA has developed a policy memo (Reference 7) that identifies four circumstances which would ordinarily require coordination with FEMA. Three of the four circumstances do not apply to this project because: a floodway has been designated in the effective study, the local community is not already in the regular FIS program, and the local community is not involved in the emergency program. The fourth circumstance involves a proposed highway crossing that encroaches on a regulatory floodway and, as such, would require an amendment to the floodway map. The project does encroach on the floodway through the construction or reconstruction of several bridges that span the floodway and have low chord elevations below the Base Flood Elevation. However, the hydraulic analysis showed that the proposed project causes a 0.00 foot increase in the floodway water surface profile. Therefore, the fourth circumstance does not apply and the project is considered to be consistent with the NFIP requirements and FEMA standards, and no revision to the floodway map is required.

## **4.0 SUMMARY**

Much of the NYS Route 198 roadway itself is located in the floodplain or Special Flood Hazard Area (SFHA). The Build Alternative is within the 1% annual chance floodplain of Scajaquada Creek as indicated by the effective FEMA FIS and the preliminary highway and bridge plans for the Build Alternative. In accordance with the provisions of 6 NYCRR 502 – Flood Plain Management for State Projects, NYSDOT has considered and evaluated the practicality of alternatives to floodplain



encroachments. Since the Build Alternative is located in a floodplain, the Part 502 regulations require that the following be determined: (1) a significant encroachment does not exist; (2) there is no significant potential for interruption or termination of a transportation facility which is needed for emergency vehicles; (3) there is no significant risk; and (4) there are no significant impacts on natural and beneficial floodplain values. The floodplain analysis conducted for this DDR/DEIS supports these four items. Revisions to the detailed hydraulic modelling will be conducted during Final Design to confirm the findings of this section; however, no substantial changes to these findings are anticipated.

## 5.0 REFERENCES

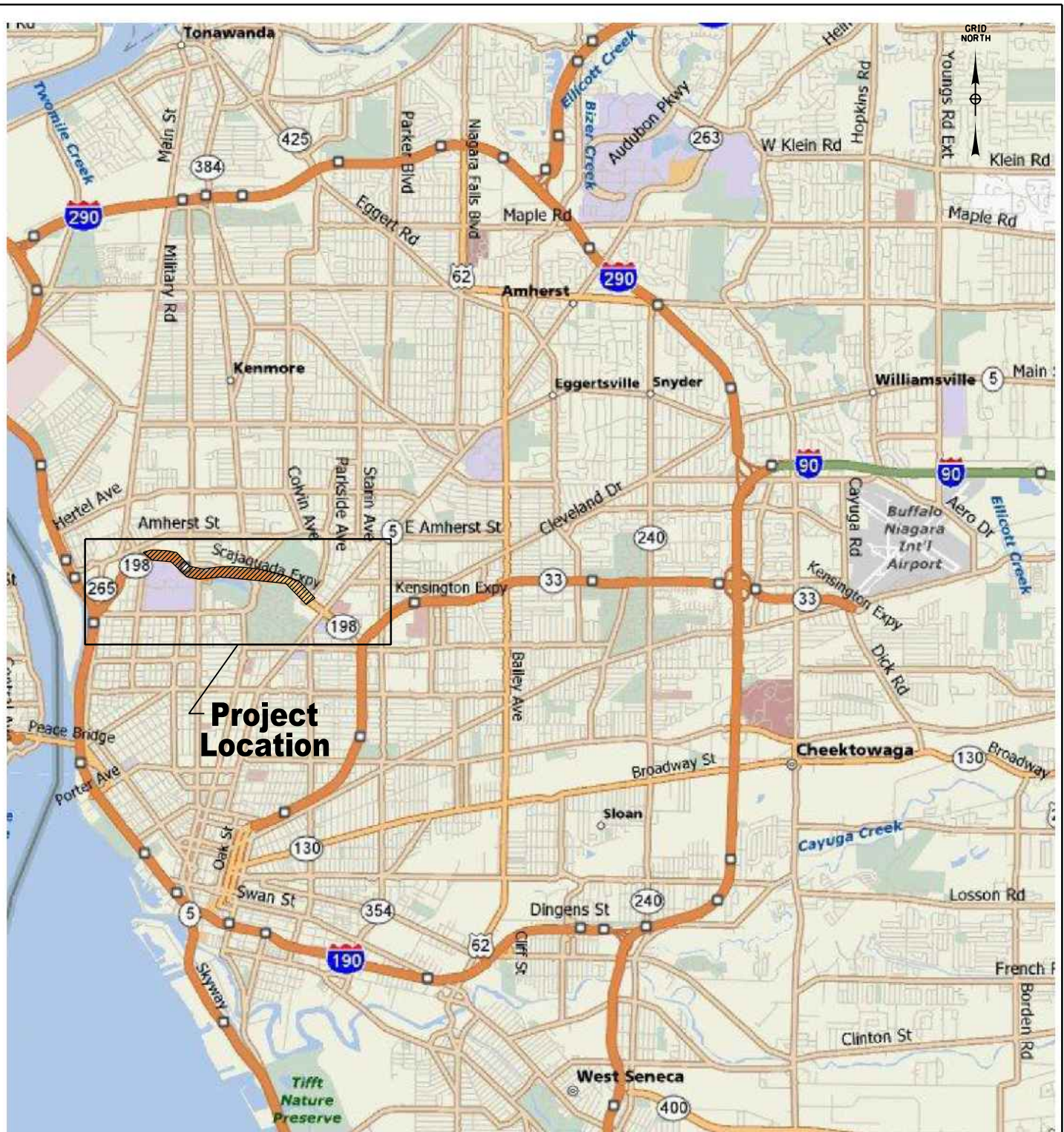
1. NYSDOT, The Environmental Manual (TEM), prepared by the NYSDOT Engineering Division - Office of Environment, April 2011. Section 4.4.5 – Floodplains.
2. Executive Order 11988 – Floodplain Management, [https://www.fws.gov/r9esnepa/NEPA\\_Handbook/EO\\_11988.pdf](https://www.fws.gov/r9esnepa/NEPA_Handbook/EO_11988.pdf) July 20, 1979.
3. Executive Order 13690 - Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input <http://www.energy.gov/sites/prod/files/2015/02/f19/EO%2013690-%20Flood%20Risk%20Management.pdf> January 30, 2015.
4. Federal Flood Risk Management Standard <http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/ffrms.pdf>
5. Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, [http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/eo11988\\_13690\\_ig.pdf](http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/eo11988_13690_ig.pdf) , October 8, 2015.
6. 44 CFR Part 60 [http://www.fema.gov/pdf/floodplain/nfip\\_sg\\_appendix\\_e.pdf](http://www.fema.gov/pdf/floodplain/nfip_sg_appendix_e.pdf) .
7. Additional Guidance on 23 CFR 650A, Attachment 2 – Procedures for Coordinating Highway Encroachments of Floodplains with Federal Emergency Management Agency (FEMA), <http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/0650asu3.cfm> , September 30, 1992.
8. 6 NYCRR Part 502 [https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=lefb9d0f0b5a011dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=\(sc.Default\)&bhcp=1](https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=lefb9d0f0b5a011dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)&bhcp=1)
9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Erie County, NY (Effective) September 26, 2008.
10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Erie County NY (Preliminary) December 31, 2009.

## **Attachment A**

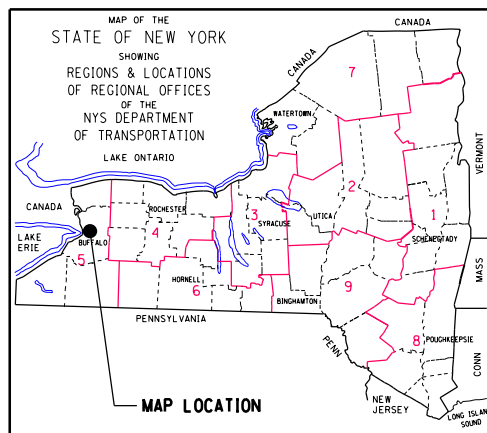
### **Project Location Map, Surface Waters Map**







SOURCE: 2008 MAPQUEST INC.



MAP LOCATION



Department of  
Transportation

**NYS Route 198**  
**(Scajaquada Expressway Corridor)**  
**P.I.N. 5470.22**

**Exhibit 1.1.1-1**  
**PROJECT LOCATION MAP**

SHEET NO.  
**1 of 1**

SCALE  
**N.T.S.**

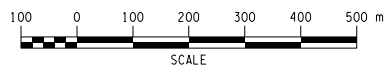
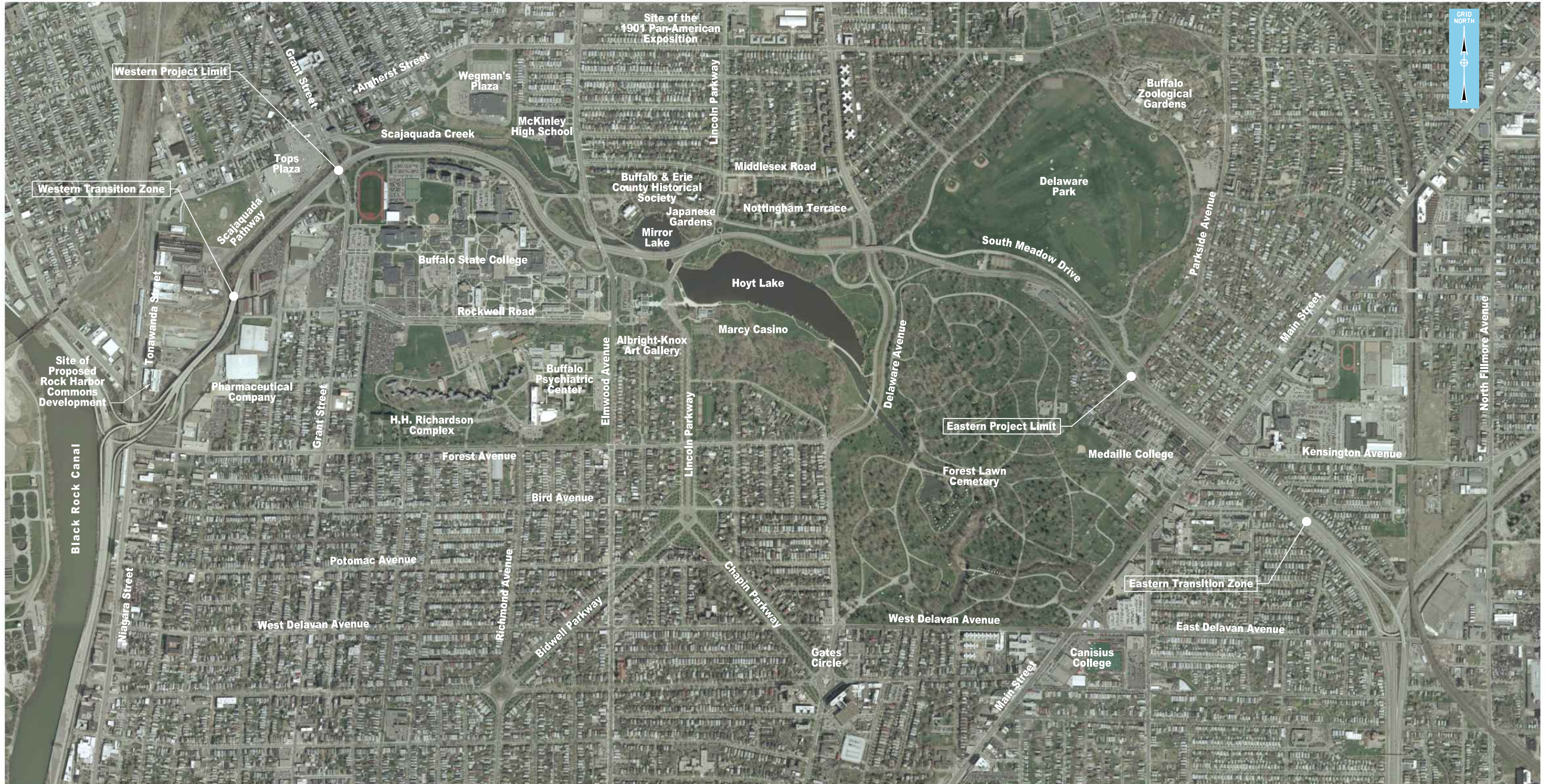
DATE  
**9/16**

**Bergmann**  
associates

Attachment A - 1



NYSDOT - REGION 5/466.00 - SCAJAUQUADA CORRIDOR/4.0 DWS/4.1 TRANSPORTATION/SCAU CORRIDOR/4.0 PRELIMINARY/PRO AREA MAP/00

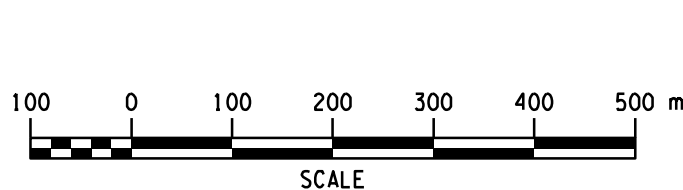
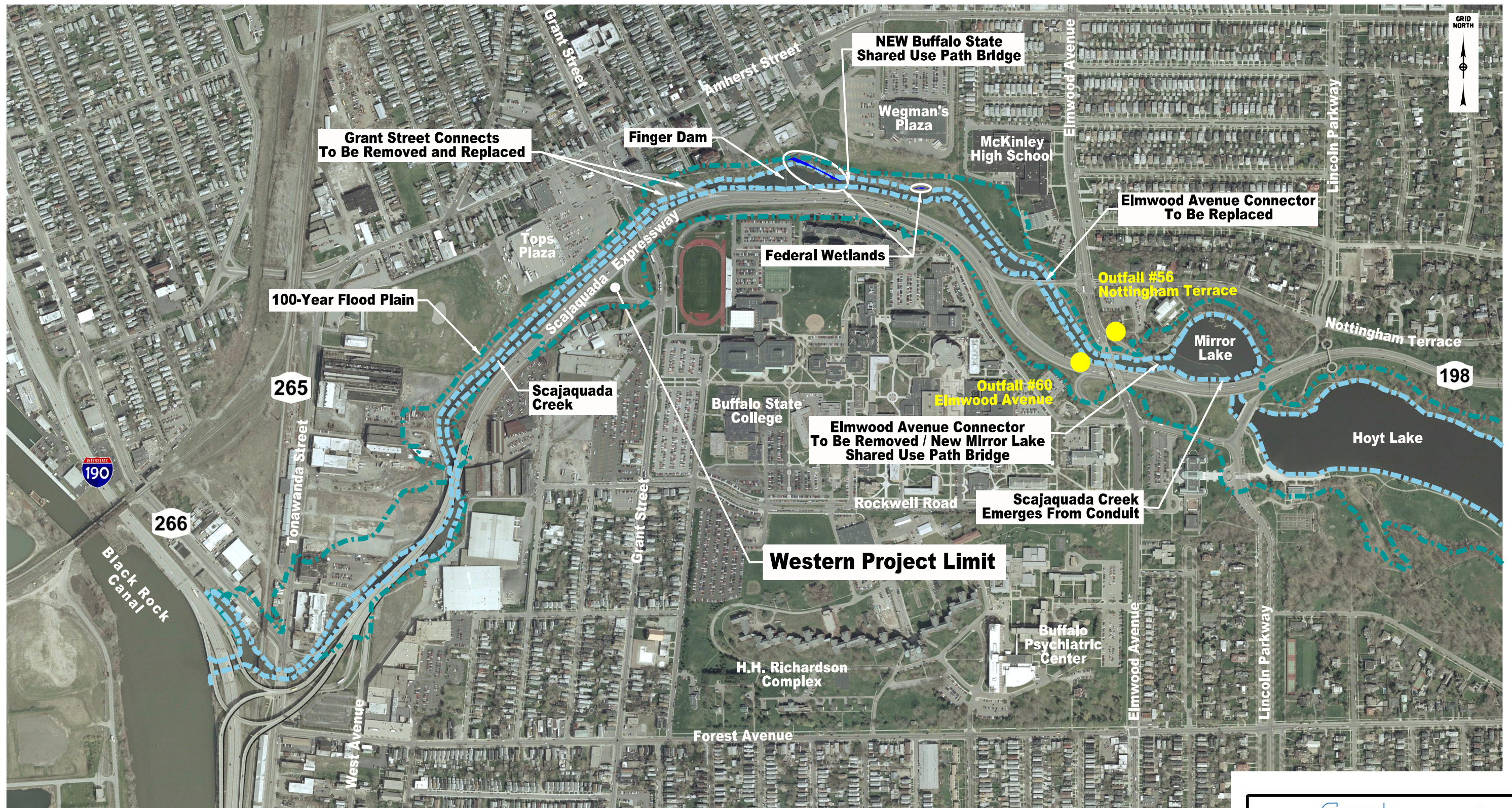


**NYS Route 198**  
**(Scajaquada Expressway Corridor)**  
**P.I.N. 5470.22**

**Exhibit 1.1.1-2**  
**Project Area Map**

SHEET NO.	SCALE	DATE	Bergmann associates
1 of 1	AS SHOWN	9/16	





- LEGEND**
- FEDERAL WETLAND AREAS
  - - - - WATERS EDGE
  - - - - 100-YEAR FLOOD PLAIN LIMIT
  - COMBINED SEWER OVERFLOW LOCATIONS

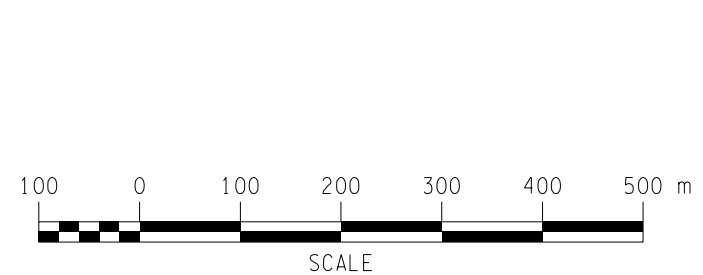
**Department of Transportation**





**NYS Route 198**  
**(Scajaquada Expressway Corridor)**  
**P.I.N. 5470.22**


**Exhibit 4.4.2-1**  
**Surface Waters**

SHEET NO. 1 of 2	SCALE AS SHOWN	DATE 9/16	
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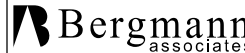


- LEGEND
-  FEDERAL WETLAND AREAS
  -  WATERS EDGE
  -  100-YEAR FLOOD PLAIN LIMIT
  -  COMBINED SEWER OVERFLOW LOCATIONS

 **Department of Transportation**

**NYS Route 198 (Scajaquada Exp.) Corridor**  
**Grant Street to Parkside Avenue**  
**P.I.N. 5470.22**

**Exhibit 4.4.2-1**  
**Surface Waters**

SHEET NO. <b>2 of 2</b>	SCALE <b>AS SHOWN</b>	DATE <b>9/16</b>	
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## **Attachment B**

### **Effective Study FEMA Products**



TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
BUFFALO RIVER					
At the mouth	431.5	*	*	37,290	*
Downstream of the confluence of Cazenovia Creek	417.2	*	*	37,290	*
Upstream of the confluence of Cazenovia Creek	280.0	*	*	21,530	*
At the upstream corporate limits	276.7	*	*	21,530	*
CAZENOVIA CREEK					
At the confluence with the Buffalo River	137.2	11,100	15,700	18,000	22,800
SCAJAQUADA CREEK					
At the mouth	28.6	2,900	4,100	4,700	6,200

\*Data not computed

Analyses of the elevations on Lake Erie were based on records for the lake gages at Buffalo, Barcelona, Erie, and Cleveland. In 1975, the USACE determined elevations for Lake Erie based on elevation-frequency curves of the annual maximum flood levels recorded at each previously mentioned gage site and adjusted to reflect present diversion and outlet conditions (Reference 11). The detailed investigation of the gage data included arithmetic, Weibull, and log-Pearson Type III analyses of both the full record length and that portion of the record subsequent to the implementation of the most recent Great Lakes Regulation Plan. Comparison of the results of these analyses with the USACE analyses resulted in negligible differences; therefore, the 2- and 100-year flood levels computed by the USACE were adopted for use in this study.

To establish the 10-, 50-, and 500-year flood elevations of Lake Erie without the effect of wave runoff, an elevation-frequency curve was established by plotting the 2- and 100-year elevations on arithmetic-probability paper and extrapolating the straight line connecting these 2 points to the 500-year frequency.

The stillwater elevations have been determined for the 10-, 50-, 100-, and 500-year floods for Lake Erie and are summarized in Table 2, "Summary of Stillwater Elevations."

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Scajaquada Creek	-115	122	1,731	2.7	581.1	581.1	581.1	0.0
A	-80	160	1,981	2.3	581.1	581.1	581.1	0.0
B	95	74	867	5.3	581.2	581.2	581.2	0.0
C	240	70	898	5.1	581.8	581.8	581.8	0.0
D	370	59	752	6.1	582.2	582.2	582.2	0.0
E	705	88	1,265	3.6	582.8	582.8	582.8	0.0
F	785	77	950	4.9	582.8	582.8	582.8	0.0
G	940	48	703	6.6	584.1	584.1	584.1	0.0
H	1,160	85	1,336	3.5	584.5	584.5	584.5	0.0
I	1,330	88	1,241	3.7	584.6	584.6	584.6	0.0
J	1,545	98	1,397	3.3	584.6	584.6	584.6	0.0
K	1,985	41	632	7.3	584.6	584.6	584.6	0.0
L	2,185	60	962	4.8	585.6	585.6	585.7	0.1
M	2,945	53	886	4.7	585.8	585.8	586.0	0.2
N	3,695	70	1,013	4.1	586.0	586.0	586.3	0.3
O	3,900	50	811	5.1	586.6	586.6	586.7	0.1
P	4,105	55	982	3.7	586.7	586.7	587.0	0.3
Q	4,320	55	895	4.1	586.8	586.8	587.1	0.3
R								

<sup>1</sup>Feet from Conrail

FEDERAL EMERGENCY MANAGEMENT AGENCY

## FLOODWAY DATA

**CITY OF BUFFALO, NY**  
(ERIE CO.)

**SCAJAQUADA CREEK**

**TABLE 3**



FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION				
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)	
Scajaquada Creek (continued)									
	S	4,455	55	837	4.4	587.0	587.0	587.1	0.1
	T	4,570	45	715	5.1	587.0	587.0	587.1	0.1
	U	4,755	69	1,142	3.2	587.1	587.1	587.4	0.3
	V	5,175	135	2,188	1.7	587.1	587.1	587.5	0.4
	W	5,200	151	1,975	1.9	587.1	587.1	587.5	0.4
	X	5,225	150	2,490	1.5	587.2	587.2	587.6	0.4
	Y	5,935	60	943	3.9	587.2	587.2	587.6	0.4
	Z	7,015	57	972	3.3	587.3	587.3	587.8	0.5
	AA	7,185	60	1,008	3.2	587.3	587.3	587.9	0.6
	AB	7,695	50	773	4.1	587.3	587.3	587.9	0.6
	AC	7,895	57	887	3.6	587.4	587.4	588.0	0.6
	AD	8,185	51	847	3.8	587.5	587.5	588.2	0.7
	AE	8,600	335	5,450	0.6	587.6	587.6	588.5	0.9
	AF	8,785	55	996	3.2	587.7	587.7	588.5	0.8
	AG	9,000	131	2,182	1.5	588.0	588.0	588.8	0.8
AH	9,605	599	11,099	0.3	588.0	588.0	588.8	0.8	
AI	10,555	420	7,945	0.4	588.0	588.0	588.8	0.8	

<sup>1</sup>Feet from Conrail

FEDERAL EMERGENCY MANAGEMENT AGENCY

## FLOODWAY DATA

**CITY OF BUFFALO, NY**  
(ERIE CO.)

**SCAJAQUADA CREEK**

**TABLE 3**

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Scajaquada Creek (continued)								
AJ	11,670	60	1,013	3.1	588.0	588.0	588.8	0.8
AK	11,765	95	1,719	1.9	588.0	588.0	588.8	0.8
AL	11,915	65	1,232	2.6	588.1	588.1	588.8	0.7
AM	12,055	76	1,397	2.3	588.1	588.1	588.8	0.7
AN	12,255	65	1,059	3.0	588.1	588.1	588.8	0.7
AO	12,575	75	1,188	2.7	588.1	588.1	588.8	0.7
AP	12,710	60	965	3.3	588.5	588.5	589.1	0.6
AQ	12,965	50	762	4.2	588.5	588.5	589.1	0.6
AR	13,465	65	857	3.7	588.5	588.5	589.2	0.7
AS	13,565	80	1,036	3.1	589.0	589.0	589.6	0.6
AT	14,455	60	292	10.9	589.0	589.0	589.6	0.6
AU	15,005	35	293	10.9	591.8	591.8	592.0	0.2
AV	15,185	41	394	8.1	593.0	593.0	593.5	0.5
AW	15,485	59	264	12.1	597.4	597.4	597.4	0.0
AX	15,835	62	268	11.9	604.4	604.4	604.4	0.0
AY	15,935	30	211	15.1	608.8	608.8	608.8	0.0

<sup>1</sup>Feet from Conrail

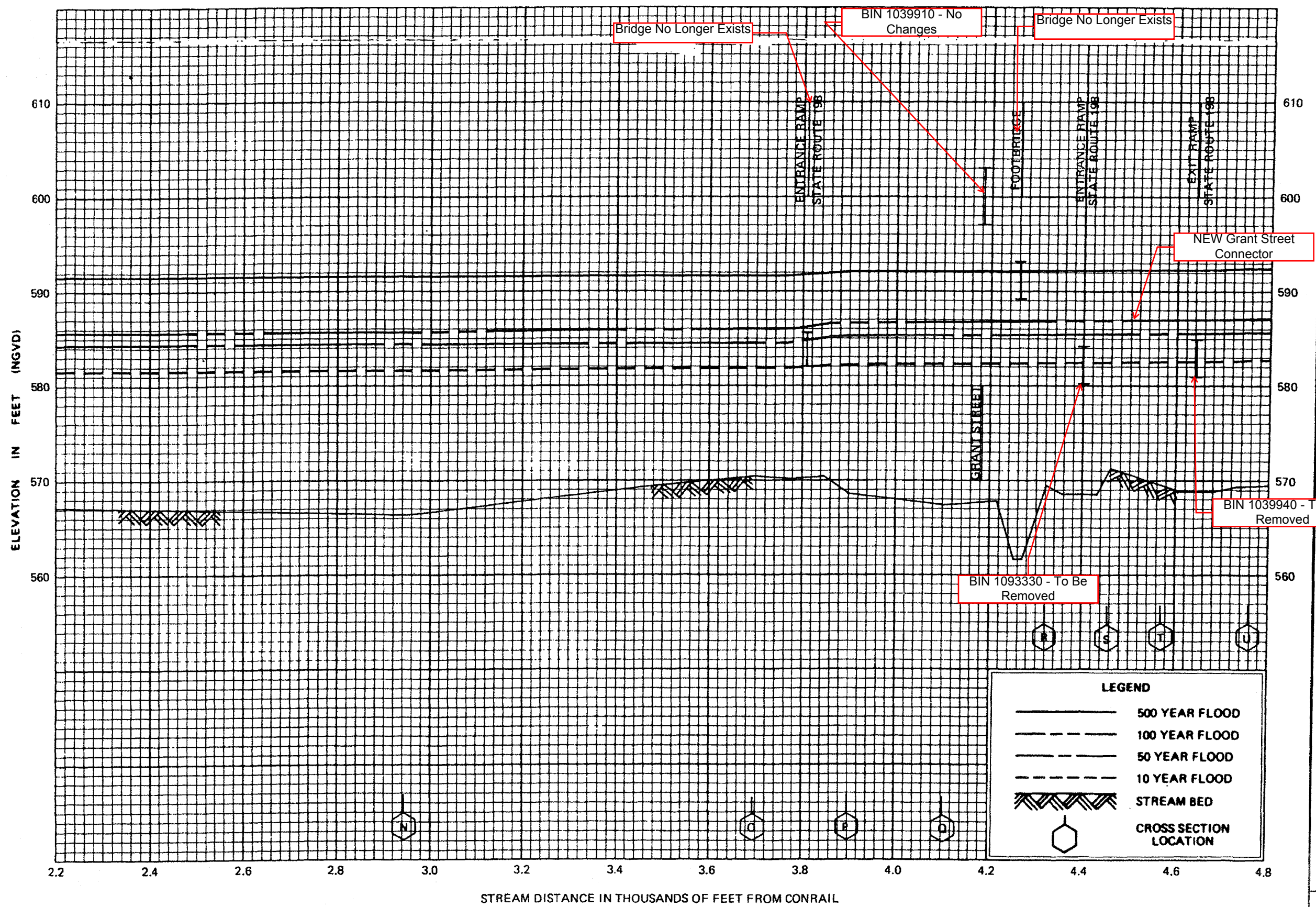
FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOODWAY DATA

**CITY OF BUFFALO, NY**  
(ERIE CO.)

**SCAJAQUADA CREEK**

**TABLE 3**



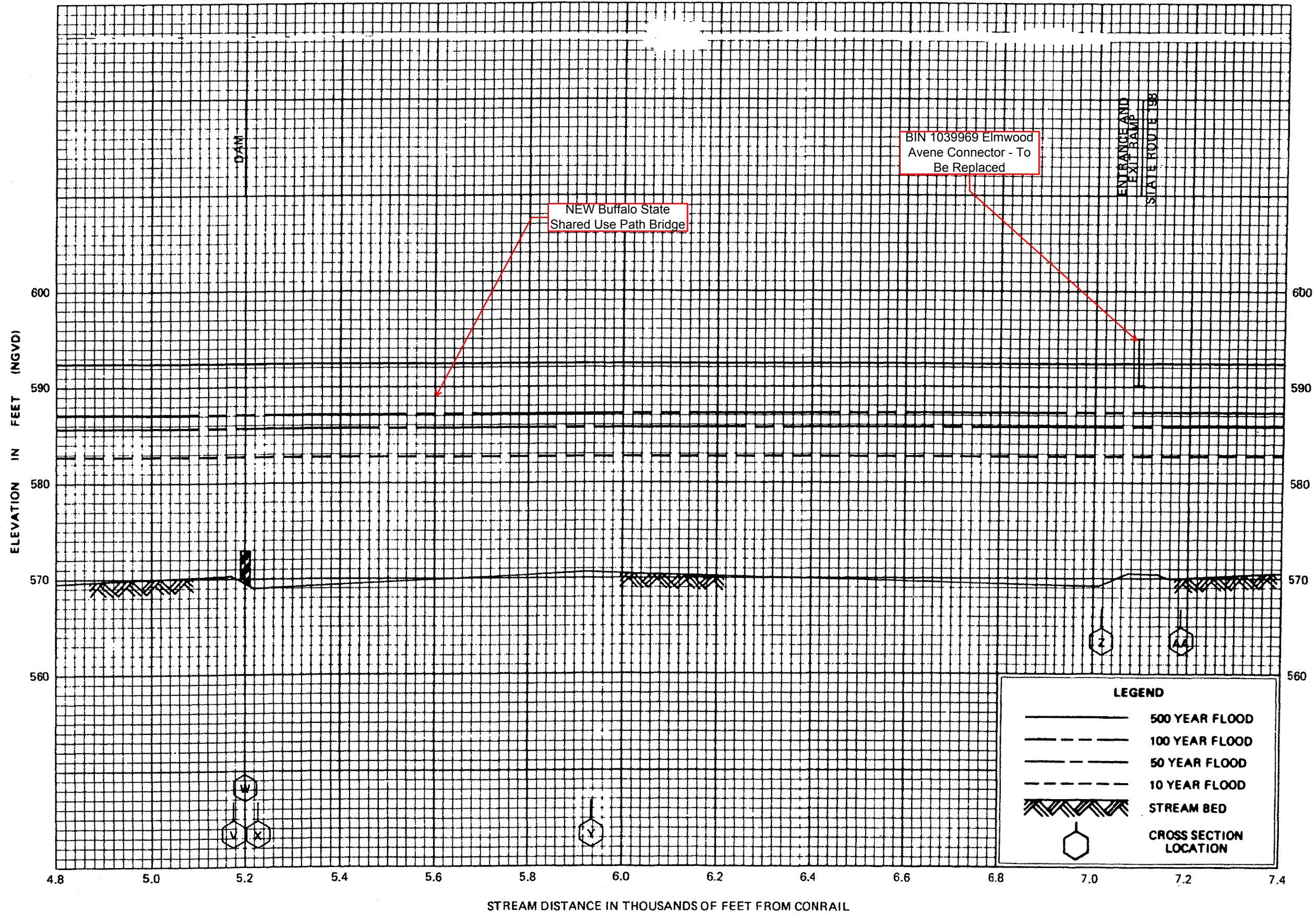
FLOOD PROFILES

SCAJAQUADA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ERIE COUNTY, NY  
(ALL JURISDICTIONS)





**FLOOD PROFILES**

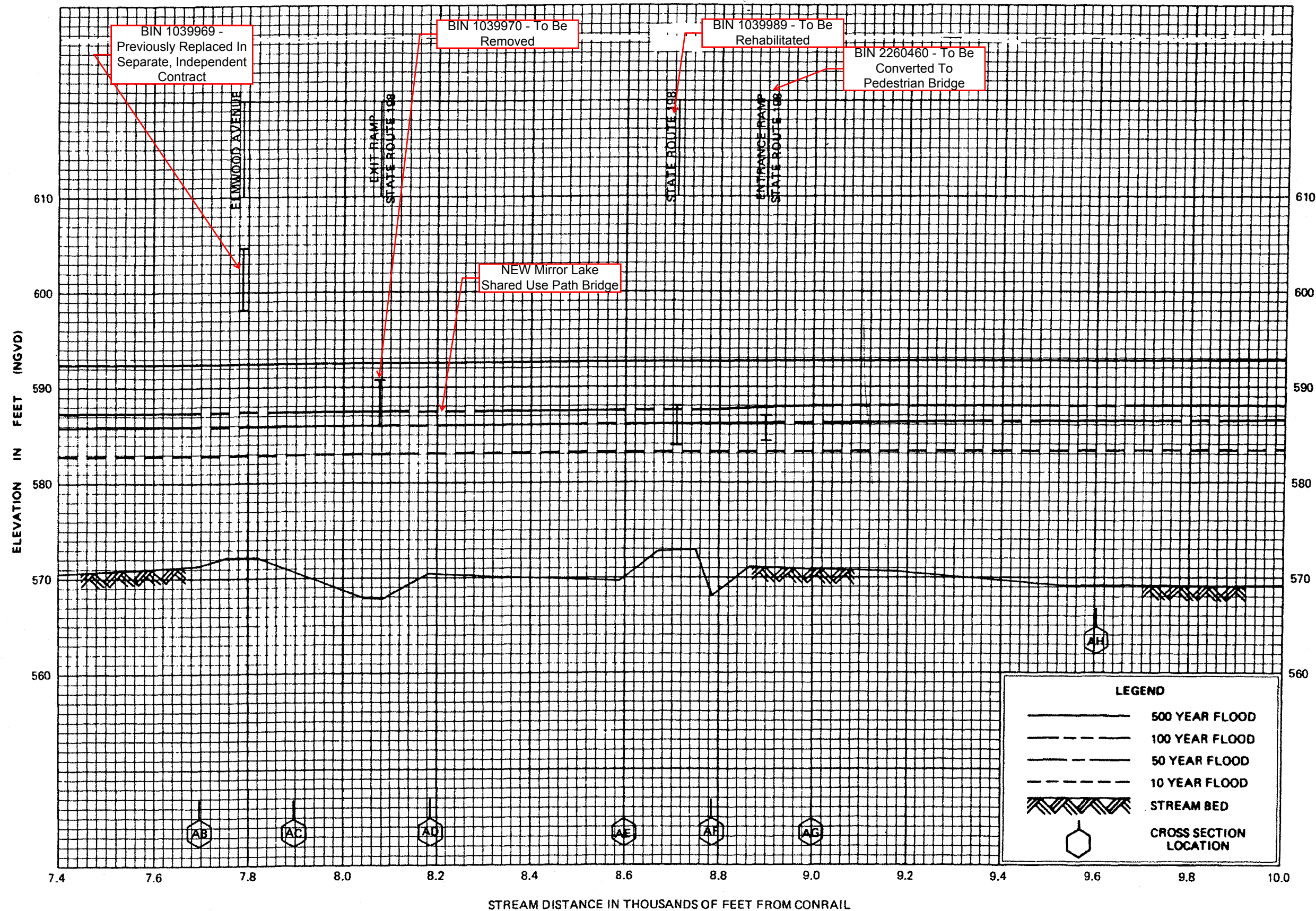
**SCAJAQUADA CREEK**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

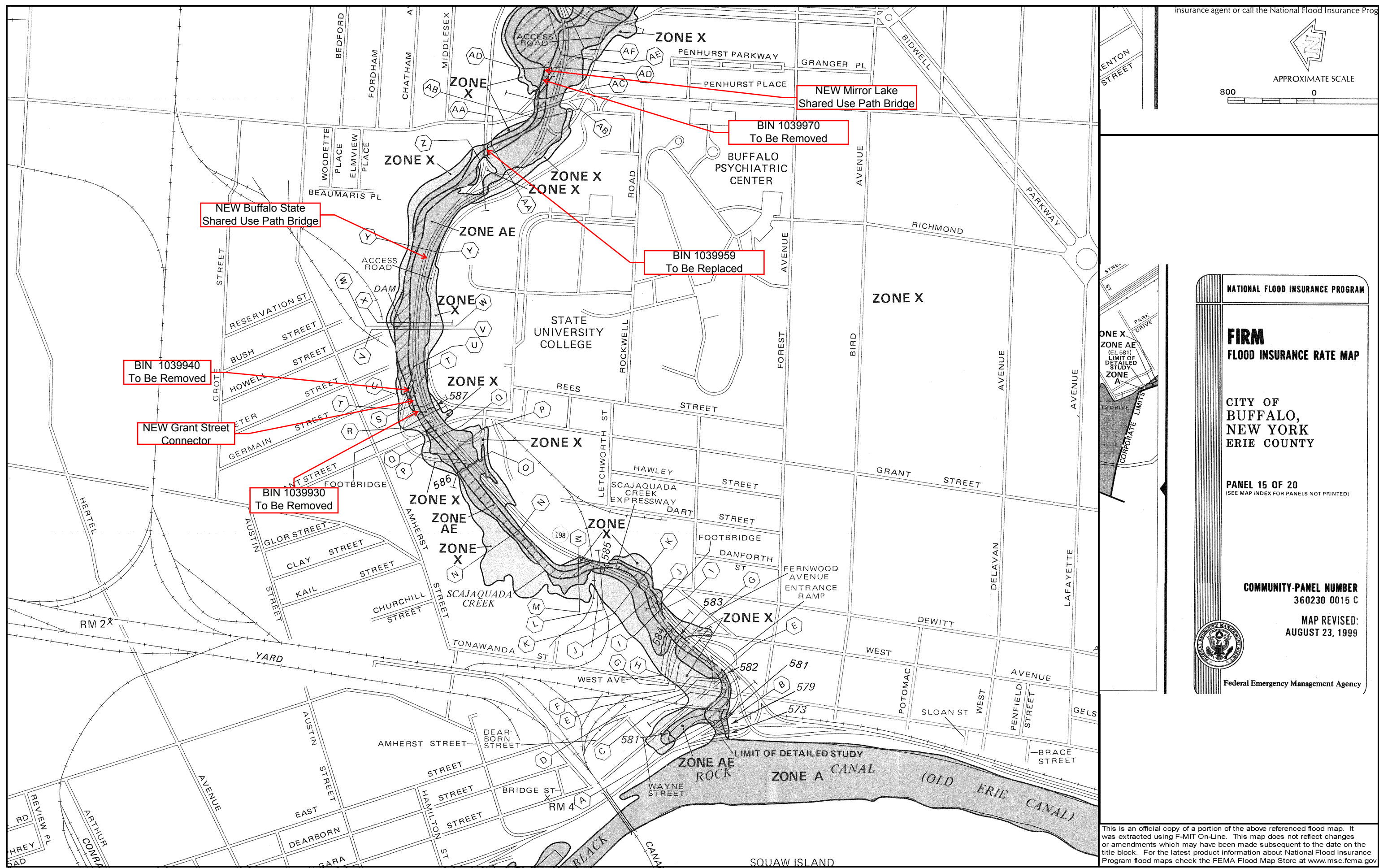
**ERIE COUNTY, NY**

**(ALL JURISDICTIONS)**

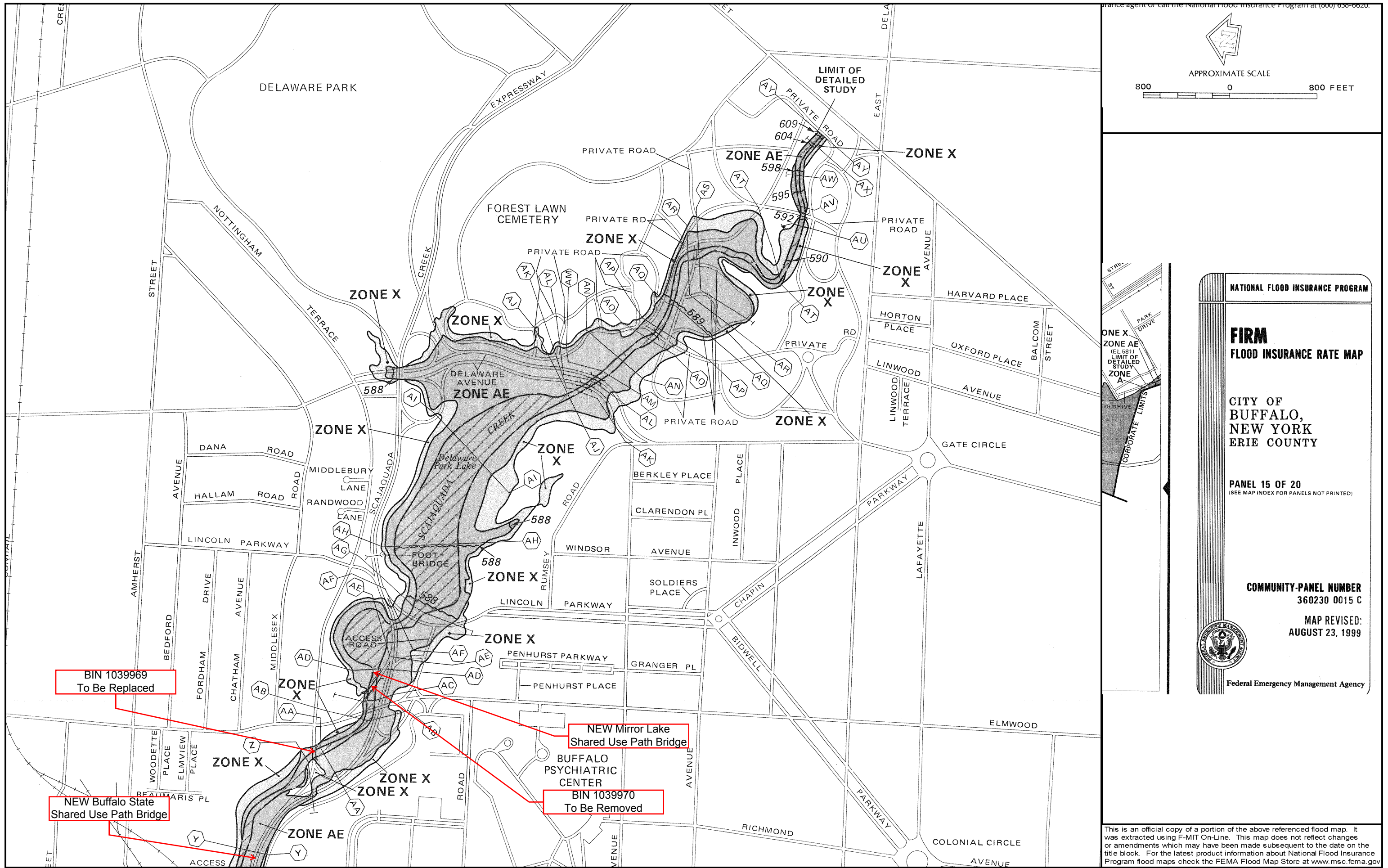














## **Attachment C**

### **Preliminary Study FEMA Products**



TABLE 8 - SUMMARY OF DISCHARGES

(Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		<u>10-</u> <u>PERCENT</u>	<u>2-</u> <u>PERCENT</u>	<u>1-</u> <u>PERCENT</u>	<u>0.2-</u> <u>PERCENT</u>
Plum Bottom Creek North Branch (Continued)					
Approximately 1,600 feet downstream of Aurora Road	1.60	300	420	480	600
Approximately 1,200 feet upstream of Aurora Road	1.00	190	280	320	420
Plum Bottom Creek South Branch					
At confluence with Slate Bottom Creek North Branch	4.10	770	1,020	1,130	1,350
At Lake Avenue	2.20	420	570	650	790
Pond Brook					
At confluence with Buffalo Creek	6.30	490	700	800	1,010
Upstream of Woodward Road	5.70	440	630	720	910
Ransom Creek					
At confluence with Tonawanda Creek	59.50	2,500	3,460	3,900	5,340
At Hopkins Road	45.70	2,300	3,190	5,120	7,910
Upstream of confluence of Black Creek	30.50	1,640	2,300	2,590	3,270
Upstream of confluence of Gott Creek	18.10	1,030	1,450	1,630	2,050
At Transit Road	17.00	971	1,360	1,540	1,930
At Goodrich Road	14.00	933	1,330	1,510	1,920
Reisch Creek					
At confluence with Lake Erie	1.30	230	340	390	520
At Prescott Drive	0.90	170	250	290	390
At Lake Shore Road	0.70	140	210	240	320
Rush Creek					
At Highland Avenue (extended)	5.10	1,260	1,740	1,910	2,390
Upstream of Tomaka Drive Tributary	4.90	960	1,320	1,450	1,820
At Tributary to Rush Creek	2.50	580	800	880	1,100
Scajaquada Creek					
At mouth	28.60	4,250	5,330	6,100	6,950

TABLE 8 - SUMMARY OF DISCHARGES

(Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE	PEAK DISCHARGES (cfs)			
	AREA (sq. miles)	<u>10-</u> PERCENT	<u>2-</u> PERCENT	<u>1-</u> PERCENT	<u>0.2-</u> PERCENT
Scajaquada Creek (Continued)					
Upstream of Dick Road Bridge	6.90	1,080	1,570	1,780	2,340
At Conrail Bridge No. 1	4.40	730	1,050	1,150	1,530
At Grant Street	2.20	400	580	630	820
Approximately 1,600 feet upstream of Grant Street	2.20	400	580	630	820
At Central Avenue	1.70	300	430	470	630
Approximately 2,300 feet upstream of Seneca Place	1.00	180	260	290	390
At Stonehedge Drive	0.20	57	75	80	89
Scajaquada Creek North Branch					
At George Urban Boulevard	1.40	250	360	410	550
Approximately 900 feet upstream of French Road	1.10	200	290	330	440
Slate Bottom Creek					
At mouth	11.60	1,760	2,360	2,710	3,200
Downstream of confluence with Slate Bottom Creek North Branch	6.10	937	1,270	1,450	1,730
Upstream of confluence with Slate Bottom Creek North Branch	6.10	682	926	1,050	1,260
Downstream of Aurora Street	3.70	657	895	1,020	1,220
Upstream of Aurora Street and Unnamed Tributary	3.00	549	759	861	1,040
At Lake Avenue	2.20	410	571	648	785
Slate Bottom Creek South Branch					
At confluence with Slate Bottom Creek South Branch	4.10	770	1,020	1,130	1,350
Downstream of Aurora Street	3.70	700	330	1,040	1,240
Upstream of Aurora Street	3.00	570	760	850	1,040

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Scajaquada Creek								
A	36	104	1026	5.9	578.4	578.4	578.6	0.2
B	160	90	982	6.2	578.5	578.5	578.8	0.3
C	232	144	1380	4.4	578.8	578.8	579.1	0.3
D	305	116	1343	4.5	579.2	579.2	579.3	0.1
E	541	84	772	7.9	579.2	579.2	579.2	0.0
F	590	80	781	7.8	579.2	579.2	579.2	0.0
G	654	71	771	7.9	579.9	579.9	580.6	0.7
H	733	68	844	7.2	580.9	580.9	581.4	0.5
I	840	67	1235	4.9	584.2	584.2	584.6	0.4
J	1002	83	1284	4.8	584.3	584.3	584.9	0.6
K	1165	166	1444	4.2	584.4	584.4	585.0	0.6
L	1287	217	2354	2.6	586.4	586.4	587.3	0.9
M	1456	158	2064	3.0	586.6	586.6	587.5	0.9
N	1639	139	1907	3.2	586.7	586.7	587.6	0.9
O	1769	180	2559	2.4	586.8	586.8	587.7	0.9
P	1969	153	2148	2.8	586.8	586.8	587.8	1.0
Q	2159	93	1276	4.8	586.8	586.8	587.7	0.9
R	2335	71	1031	6.7	587.5	587.5	588.3	0.8
S	2499	147	2467	2.5	590.4	590.4	591.3	0.9
T	2763	86	1722	3.5	590.4	590.4	591.3	0.9
U	3225	102	1815	3.4	590.5	590.5	591.4	0.9
V	4152	126	2100	2.9	590.7	590.7	591.6	0.9
W	4546	168	2379	2.6	590.8	590.8	591.8	1.0
X	4780	186	2609	2.3	591.0	591.0	591.9	0.9
Y	5054	226	3470	1.8	591.2	591.2	592.2	1.0
Z	5422	290	4380	1.4	591.3	591.3	592.3	1.0

<sup>1</sup> Feet above confluence with Black Rock Canal

**TABLE 10**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**ERIE COUNTY, NEW YORK  
(ALL JURISDICTIONS)**

**FLOODWAY DATA**

**SCAJAQUADA CREEK**

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Scajaquada Creek (Continued)								
AA	5543	310	4642	1.3	591.3	591.3	592.3	1.0
AB	6265	241	2694	2.3	591.3	591.3	592.3	1.0
AC	6666	307	3644	1.7	591.4	591.4	592.4	1.0
AD	7054	319	3203	1.9	591.4	591.4	592.4	1.0
AE	7503	392	4756	1.3	591.5	591.5	592.5	1.0
AF	7854	269	3269	1.9	591.5	591.5	592.5	1.0
AG	8167	203	3039	2.0	591.6	591.6	592.6	1.0
AH	8429	222	2903	2.1	591.8	591.8	592.7	0.9
AI	8967	295	3578	2.0	591.8	591.8	592.8	1.0
AJ	9121	265	3877	1.6	592.0	592.0	593.0	1.0
AK	9332	299	5754	1.1	592.1	592.1	593.1	1.0
AL	10066	608	14928	0.4	592.1	592.1	593.1	1.0
AM	10921	455	10330	0.6	592.1	592.1	593.1	1.0
AN	11835	487	5888	1.0	592.1	592.1	593.1	1.0
AO	12017	553	6112	1.0	592.1	592.1	593.1	1.0
AP	12272	595	7177	0.9	592.1	592.1	593.1	1.0
AQ	12734	379	4260	1.4	592.1	592.1	593.1	1.0
AR	12989	333	3886	1.6	592.2	592.2	593.2	1.0
AS	13237	296	4493	1.4	592.3	592.2	593.2	1.0
AT	13600	347	3558	1.7	592.3	592.2	593.2	1.0
AU	13867	319	3669	1.7	592.3	592.3	593.3	1.0
AV	14174	249	2586	2.4	592.4	592.4	593.4	1.0
AW	14760	219	1186	5.1	592.5	592.5	593.5	1.0
AX	15255	72	531	11.5	592.5	592.5	593.2	0.7
AY	15449	69	693	8.8	596.3	596.3	597.3	1.0

<sup>1</sup> Feet above confluence with Black Rock Canal

**TABLE 10**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

**ERIE COUNTY, NEW YORK  
(ALL JURISDICTIONS)**

**FLOODWAY DATA**

**SCAJAQUADA CREEK**

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Scajaquada Creek (Continued)								
AZ	15666 <sup>1</sup>	82	499	12.2	596.8	596.8	597.4	0.6
BA	16170 <sup>1</sup>	54	408	15.0	611.3	611.3	611.4	0.1
BB	47890 <sup>1</sup>	77	603	3.6	650.2	650.2	650.2	0.0
BC	49843 <sup>1</sup>	92	653	3.4	651.9	651.9	652.0	0.1
BD	53064 <sup>1</sup>	67	479	4.6	654.9	654.9	655.3	0.4
BE	57702 <sup>1</sup>	71	383	3.4	660.4	660.4	660.5	0.1
BF	60964 <sup>1</sup>	57	377	3.1	662.6	662.6	663.1	0.5
BG	62836 <sup>1</sup>	30	170	6.1	666.5	666.5	666.7	0.2
BH	69493 <sup>1</sup>	41	172	3.7	679.3	679.3	679.4	0.1
BI	73420 <sup>1</sup>	31	156	3.0	693.6	693.6	693.6	0.0
BJ	74860 <sup>1</sup>	91	383	1.2	696.6	696.6	697.5	0.9
BK	76360 <sup>1</sup>	70	254	1.8	700.1	700.1	701.1	1.0
BL	77950 <sup>1</sup>	20	78	3.7	704.2	704.2	704.9	0.7
BM	79620 <sup>1</sup>	25	68	4.2	708.6	708.6	709.4	0.8
Scajaquada Creek North Branch								
A	1015 <sup>2</sup>	29	99	4.1	668.1	668.1	668.2	0.1
B	2087 <sup>2</sup>	12	42	9.8	670.9	670.9	670.9	0.0
Scajaquada Creek Tributary T-1								
A	3928 <sup>2</sup>	*	*	*	646.7	*	*	*

<sup>1</sup> Feet above confluence with Black Rock Canal

<sup>2</sup> Feet above confluence with Scajaquada Creek

\* Data not available

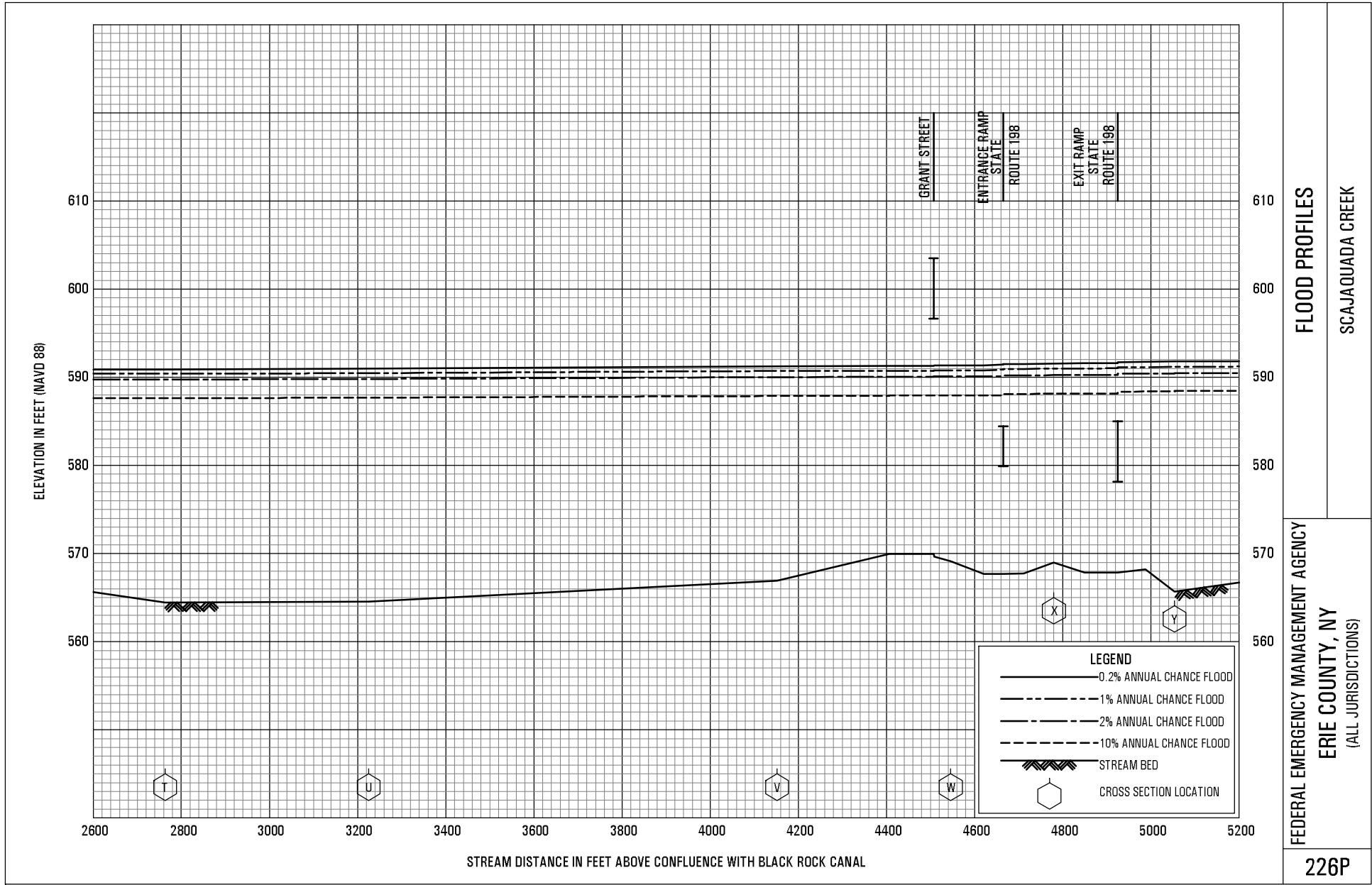
**TABLE 10**

**FEDERAL EMERGENCY MANAGEMENT AGENCY**

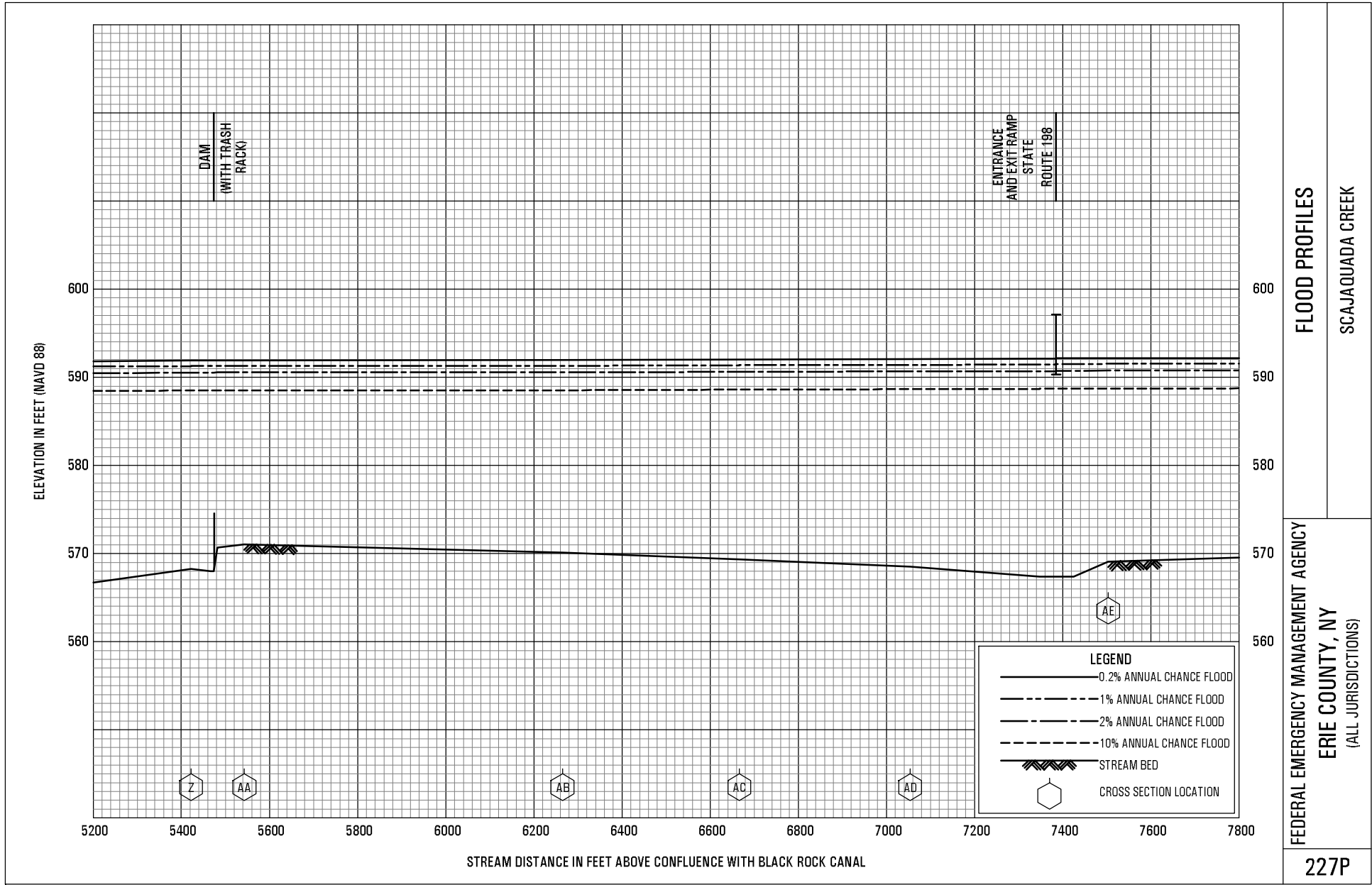
**ERIE COUNTY, NEW YORK  
(ALL JURISDICTIONS)**

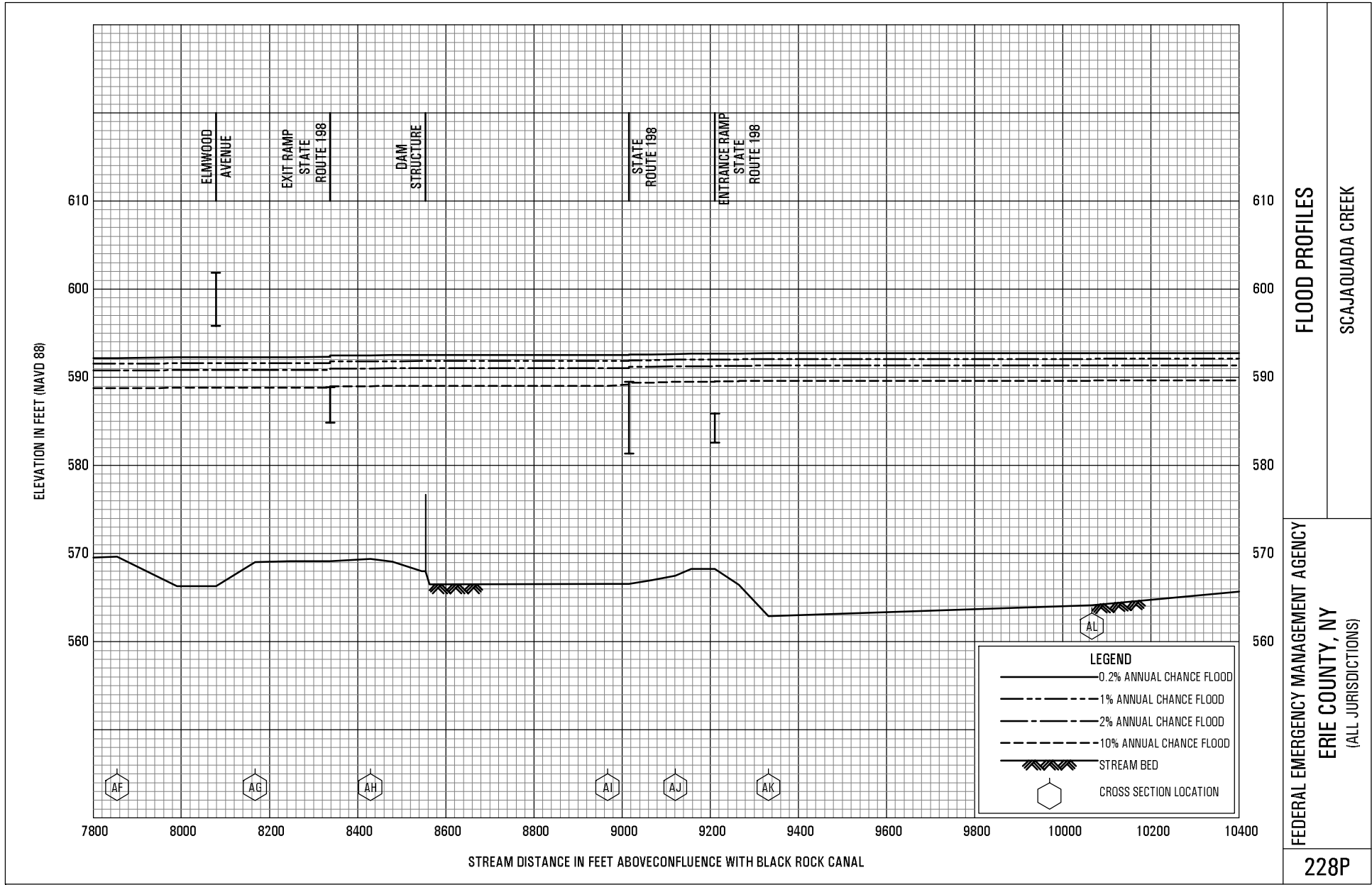
**FLOODWAY DATA**

**SCAJAQUADA CREEK - SCAJAQUADA CREEK NORTH BRANCH -  
SCAJAQUADA CREEK TRIBUTARY T-1**



















**NYS Route 198**  
(Scajaquada Expressway Corridor)  
P.I.N. 5470.22

**Preliminary FIS Map**

SHEET NO. 1 of 1	SCALE N.T.S.	DATE 09/16	
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## **Attachment D**

### **Selected HEC-RAS Model Output**



# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 100

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Scajaquada Creek	2712.8	100	FEMAEffRegEx	133.10	172.75	179.00	175.67	179.01	0.000019	0.30	498.40	191.00	0.05
Scajaquada Creek	2712.8	100	FEMAEffRegProp	133.10	172.75	179.00	175.67	179.01	0.000019	0.30	498.17	190.86	0.05
Scajaquada Creek	2644.9	100	FEMAEffRegEx	133.10	171.80	179.00	175.18	179.01	0.000003	0.17	821.56	187.59	0.02
Scajaquada Creek	2644.9	100	FEMAEffRegProp	133.10	171.80	179.00	175.18	179.00	0.000003	0.17	821.33	187.56	0.02
Scajaquada Creek	2597.1	100	FEMAEffRegEx	133.10	173.75	179.00	175.07	179.00	0.000029	0.41	433.03	179.05	0.06
Scajaquada Creek	2597.1	100	FEMAEffRegProp	133.10	173.75	179.00	175.07	179.00	0.000029	0.41	432.81	179.03	0.06
Scajaquada Creek	2579.2	100	FEMAEffRegEx	133.10	173.49	178.99	175.40	179.00	0.000051	0.56	383.72	189.65	0.08
Scajaquada Creek	2579.2	100	FEMAEffRegProp	133.10	173.49	178.98	175.39	178.99	0.000052	0.57	382.09	189.49	0.08
Scajaquada Creek	2551.4			Bridge									
Scajaquada Creek	2538.0	100	FEMAEffRegEx	133.10	173.31	178.98	175.12	178.99	0.000053	0.58	336.60	153.16	0.08
Scajaquada Creek	2538.0	100	FEMAEffRegProp	133.10	173.31	178.98	175.12	178.99	0.000053	0.58	336.46	153.15	0.08
Scajaquada Creek	2483.8	100	FEMAEffRegEx	133.10	173.70	178.96	175.75	178.98	0.000128	0.82	211.99	77.75	0.13
Scajaquada Creek	2483.8	100	FEMAEffRegProp	133.10	173.70	178.96	175.75	178.99	0.000128	0.82	212.13	77.76	0.13
Scajaquada Creek	2468.2			Bridge									
Scajaquada Creek	2447.9	100	FEMAEffRegEx	133.10	173.45	178.95		178.98	0.000137	0.85	210.47	80.38	0.13
Scajaquada Creek	2447.9	100	FEMAEffRegProp	133.10	173.45	178.95		178.98	0.000137	0.85	210.62	80.51	0.13
Scajaquada Creek	2374.2	100	FEMAEffRegEx	133.10	173.04	178.93		178.96	0.000153	0.95	208.12	92.73	0.14
Scajaquada Creek	2374.2	100	FEMAEffRegProp	133.10	173.04	178.93		178.97	0.000153	0.95	208.30	92.78	0.14
Scajaquada Creek	2312.8	100	FEMAEffRegEx	133.10	172.98	178.92		178.95	0.000134	0.91	237.66	122.57	0.13
Scajaquada Creek	2312.8	100	FEMAEffRegProp	133.10	172.98	178.92		178.96	0.000134	0.90	237.90	122.64	0.13
Scajaquada Creek	2271.6	100	FEMAEffRegEx	133.10	173.44	178.90	175.56	178.95	0.000187	0.96	144.28	42.97	0.15
Scajaquada Creek	2271.6	100	FEMAEffRegProp	133.10	173.44	178.90	175.56	178.95	0.000187	0.96	144.36	42.98	0.15
Scajaquada Creek	2256.6			Bridge									
Scajaquada Creek	2242.1	100	FEMAEffRegEx	133.10	173.46	178.89	175.56	178.94	0.000194	0.98	142.78	49.98	0.15
Scajaquada Creek	2242.1	100	FEMAEffRegProp	133.10	173.46	178.89	175.56	178.94	0.000194	0.98	142.90	50.07	0.15
Scajaquada Creek	2157.3	100	FEMAEffRegEx	133.10	172.89	178.88	175.31	178.92	0.000116	0.82	172.38	53.05	0.12
Scajaquada Creek	2157.3	100	FEMAEffRegProp	133.10	172.89	178.89	175.31	178.92	0.000115	0.82	172.50	53.07	0.12
Scajaquada Creek	1895.4	100	FEMAEffRegEx	133.10	173.46	178.82	175.80	178.87	0.000239	1.04	147.06	75.66	0.17
Scajaquada Creek	1895.4	100	FEMAEffRegProp	133.10	173.46	178.82	175.80	178.88	0.000238	1.04	147.25	75.68	0.17
Scajaquada Creek	1821.8	100	FEMAEffRegEx	133.10	173.13	178.79	175.69	178.85	0.000250	1.14	123.96	42.12	0.18
Scajaquada Creek	1821.8	100	FEMAEffRegProp	133.10	173.13	178.79	175.69	178.86	0.000248	1.15	124.05	42.16	0.18
Scajaquada Creek	1790.8	100	FEMAEffRegEx	133.10	173.04	178.78	175.62	178.85	0.000271	1.18	116.62	32.90	0.18

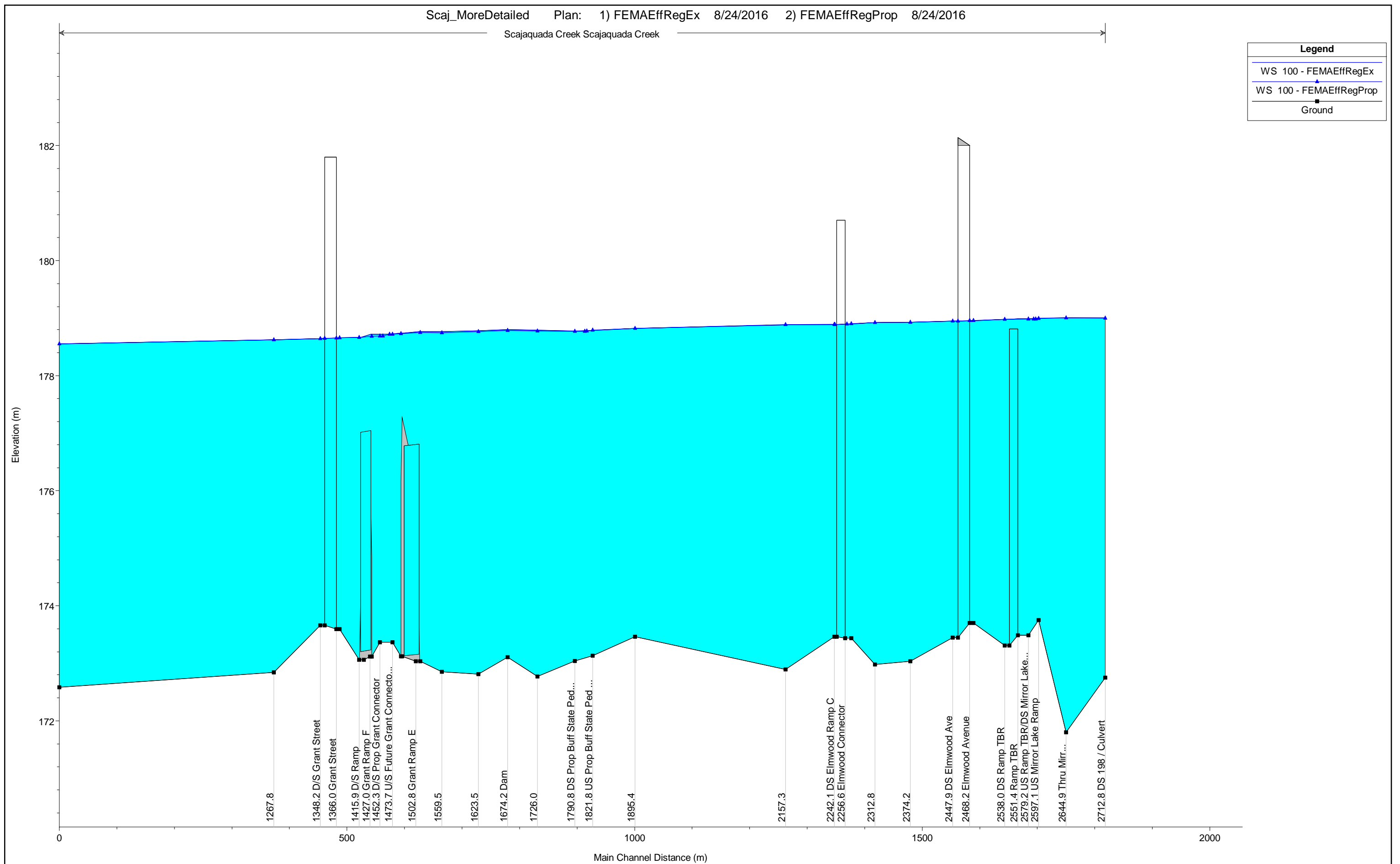
# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 100 (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Scajaquada Creek	1790.8	100	FEMAEffRegProp	133.10	173.04	178.77	175.62	178.84	0.000285	1.16	116.43	32.87	0.19
Scajaquada Creek	1726.0	100	FEMAEffRegEx	133.10	172.77	178.79	175.08	178.82	0.000107	0.76	176.14	45.80	0.12
Scajaquada Creek	1726.0	100	FEMAEffRegProp	133.10	172.77	178.78	175.08	178.81	0.000110	0.76	175.45	45.25	0.12
Scajaquada Creek	1674.2	100	FEMAEffRegEx	133.10	173.11	178.80	174.34	178.81	0.000038	0.51	295.35	96.41	0.07
Scajaquada Creek	1674.2	100	FEMAEffRegProp	133.10	173.11	178.79	174.34	178.80	0.000039	0.51	293.88	95.26	0.07
Scajaquada Creek	1623.5	100	FEMAEffRegEx	133.10	172.81	178.78	175.04	178.81	0.000108	0.77	207.96	77.54	0.12
Scajaquada Creek	1623.5	100	FEMAEffRegProp	133.10	172.81	178.76	175.04	178.79	0.000111	0.83	206.52	77.41	0.12
Scajaquada Creek	1559.5	100	FEMAEffRegEx	133.10	172.86	178.77	175.26	178.80	0.000146	0.89	191.62	72.96	0.14
Scajaquada Creek	1559.5	100	FEMAEffRegProp	133.10	172.86	178.74	175.26	178.79	0.000151	1.00	190.00	72.87	0.14
Scajaquada Creek	1522.4	100	FEMAEffRegEx	133.10	173.03	178.77	174.79	178.79	0.000114	0.79	231.19	89.39	0.11
Scajaquada Creek	1522.4	100	FEMAEffRegProp	133.10	173.03	178.75	174.79	178.78	0.000115	0.80	229.53	89.29	0.11
Scajaquada Creek	1502.8			Culvert									
Scajaquada Creek	1488.5	100	FEMAEffRegEx	133.10	173.12	178.74	174.86	178.78	0.000154	0.93	193.96	93.97	0.13
Scajaquada Creek	1488.5	100	FEMAEffRegProp	133.10	173.12	178.73	174.86	178.77	0.000155	0.94	193.15	93.94	0.13
Scajaquada Creek	1473.7	100	FEMAEffRegEx	133.10	173.37	178.72	175.77	178.77	0.000227	1.06	164.31	64.41	0.17
Scajaquada Creek	1473.7	100	FEMAEffRegProp	133.10	173.37	178.72	175.77	178.77	0.000226	1.07	164.01	64.37	0.17
Scajaquada Creek	1452.3	100	FEMAEffRegEx	133.10	173.37	178.72	175.77	178.76	0.000213	1.05	177.76	76.87	0.16
Scajaquada Creek	1452.3	100	FEMAEffRegProp	133.10	173.37	178.69	175.77	178.74	0.000219	1.07	175.34	76.60	0.16
Scajaquada Creek	1438.1	100	FEMAEffRegEx	133.10	173.12	178.72	175.25	178.76	0.000205	1.00	183.03	83.22	0.15
Scajaquada Creek	1438.1	100	FEMAEffRegProp	133.10	173.12	178.69	175.26	178.73	0.000209	1.04	180.30	82.80	0.15
Scajaquada Creek	1427.0			Culvert									
Scajaquada Creek	1415.9	100	FEMAEffRegEx	133.10	173.06	178.67	175.26	178.73	0.000347	1.24	159.64	85.59	0.17
Scajaquada Creek	1415.9	100	FEMAEffRegProp	133.10	173.06	178.66	175.26	178.72	0.000348	1.25	159.28	85.51	0.17
Scajaquada Creek	1381.8	100	FEMAEffRegEx	133.10	173.59	178.66	175.77	178.71	0.000247	1.09	154.90	69.11	0.17
Scajaquada Creek	1381.8	100	FEMAEffRegProp	133.10	173.59	178.66	175.77	178.71	0.000247	1.09	154.90	69.11	0.17
Scajaquada Creek	1366.0			Bridge									
Scajaquada Creek	1348.2	100	FEMAEffRegEx	133.10	173.66	178.65	175.82	178.70	0.000248	1.08	156.15	67.69	0.17
Scajaquada Creek	1348.2	100	FEMAEffRegProp	133.10	173.66	178.65	175.82	178.70	0.000248	1.08	156.15	67.69	0.17
Scajaquada Creek	1267.8	100	FEMAEffRegEx	133.10	172.84	178.62	175.29	178.68	0.000224	1.09	159.09	85.87	0.17
Scajaquada Creek	1267.8	100	FEMAEffRegProp	133.10	172.84	178.62	175.29	178.68	0.000224	1.09	159.09	85.87	0.17
Scajaquada Creek	894.8	100	FEMAEffRegEx	133.10	172.58	178.55	174.82	178.60	0.000180	1.03	133.72	33.01	0.15
Scajaquada Creek	894.8	100	FEMAEffRegProp	133.10	172.58	178.55	174.82	178.60	0.000180	1.03	133.72	33.01	0.15

Scaj\_MoreDetailed Plan: 1) FEMAEffRegEx 8/24/2016 2) FEMAEffRegProp 8/24/2016

Scajaquada Creek Scajaquada Creek





Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 100

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Enc Sta L (m)	Enc Sta R (m)
Scajaquada Creek	2712.8	100	FEMAEffRegPropFW	133.10	172.75	179.17	0.31	433.65	107.10	0.05	108.30	215.40
Scajaquada Creek	2712.8	100	FEMAEffRegExFW	133.10	172.75	179.18	0.31	434.66	107.10	0.05	108.30	215.40
Scajaquada Creek	2644.9	100	FEMAEffRegPropFW	133.10	171.80	179.17	0.17	778.61	125.41	0.02	106.00	231.41
Scajaquada Creek	2644.9	100	FEMAEffRegExFW	133.10	171.80	179.18	0.17	779.80	125.41	0.02	106.00	231.41
Scajaquada Creek	2597.1	100	FEMAEffRegPropFW	133.10	173.75	179.16	0.47	281.67	60.91	0.07	124.75	185.66
Scajaquada Creek	2597.1	100	FEMAEffRegExFW	133.10	173.75	179.17	0.47	282.25	60.91	0.07	124.75	185.66
Scajaquada Creek	2588			Bridge								
Scajaquada Creek	2579.2	100	FEMAEffRegPropFW	133.10	173.49	179.11	0.54	406.54	191.79	0.08		
Scajaquada Creek	2579.2	100	FEMAEffRegExFW	133.10	173.49	179.16	0.69	217.02	53.81	0.10	138.96	192.77
Scajaquada Creek	2538.0	100	FEMAEffRegPropFW	133.10	173.31	179.10	0.66	224.53	53.81	0.09	129.53	183.34
Scajaquada Creek	2538.0	100	FEMAEffRegExFW	133.10	173.31	179.10	0.66	224.87	53.81	0.09	129.53	183.34
Scajaquada Creek	2483.8	100	FEMAEffRegPropFW	133.10	173.70	179.05	1.03	128.78	29.83	0.16	116.20	146.03
Scajaquada Creek	2483.8	100	FEMAEffRegExFW	133.10	173.70	179.05	1.03	128.77	29.83	0.16	116.20	146.03
Scajaquada Creek	2468.2			Bridge								
Scajaquada Creek	2447.9	100	FEMAEffRegPropFW	133.10	173.45	179.03	1.11	120.20	27.96	0.17	136.55	164.51
Scajaquada Creek	2447.9	100	FEMAEffRegExFW	133.10	173.45	179.03	1.11	120.19	27.96	0.17	136.55	164.51
Scajaquada Creek	2374.2	100	FEMAEffRegPropFW	133.10	173.04	178.99	1.23	111.21	24.00	0.18	64.54	88.54
Scajaquada Creek	2374.2	100	FEMAEffRegExFW	133.10	173.04	178.99	1.23	111.20	24.00	0.18	64.54	88.54
Scajaquada Creek	2312.8	100	FEMAEffRegPropFW	133.10	172.98	178.97	1.25	108.12	22.68	0.18	127.33	150.01
Scajaquada Creek	2312.8	100	FEMAEffRegExFW	133.10	172.98	178.97	1.25	108.11	22.68	0.18	127.33	150.01
Scajaquada Creek	2271.6	100	FEMAEffRegPropFW	133.10	173.44	178.99	0.96	139.11	33.55	0.15	132.66	166.21
Scajaquada Creek	2271.6	100	FEMAEffRegExFW	133.10	173.44	178.99	0.96	139.10	33.55	0.15	132.66	166.21
Scajaquada Creek	2256.6			Bridge								
Scajaquada Creek	2242.1	100	FEMAEffRegPropFW	133.10	173.46	178.98	0.97	137.22	32.92	0.15	110.30	143.22
Scajaquada Creek	2242.1	100	FEMAEffRegExFW	133.10	173.46	178.98	0.97	137.26	32.92	0.15	110.30	143.22
Scajaquada Creek	2157.3	100	FEMAEffRegPropFW	133.10	172.89	178.97	0.82	161.65	34.83	0.12	75.25	110.08
Scajaquada Creek	2157.3	100	FEMAEffRegExFW	133.10	172.89	178.97	0.82	161.70	34.83	0.12	75.25	110.08
Scajaquada Creek	1895.4	100	FEMAEffRegPropFW	133.10	173.46	178.90	1.06	125.27	32.45	0.17	119.11	151.56
Scajaquada Creek	1895.4	100	FEMAEffRegExFW	133.10	173.46	178.90	1.06	125.31	32.45	0.17	119.11	151.56

Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 100 (Continued)

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Enc Sta L (m)	Enc Sta R (m)
Scajaquada Creek	1821.8	100	FEMAEffRegPropFW	133.10	173.13	178.87	1.14	117.05	27.28	0.18	97.72	125.00
Scajaquada Creek	1821.8	100	FEMAEffRegExFW	133.10	173.13	178.87	1.14	117.09	27.28	0.18	97.72	125.00
Scajaquada Creek	1805			Bridge								
Scajaquada Creek	1790.8	100	FEMAEffRegPropFW	133.10	173.04	178.85	1.17	113.50	26.38	0.18	95.69	122.07
Scajaquada Creek	1790.8	100	FEMAEffRegExFW	133.10	173.04	178.86	1.17	113.84	26.38	0.18	95.69	122.07
Scajaquada Creek	1726.0	100	FEMAEffRegPropFW	133.10	172.77	178.86	0.75	176.53	40.40	0.12	106.69	147.09
Scajaquada Creek	1726.0	100	FEMAEffRegExFW	133.10	172.77	178.88	0.75	177.41	40.40	0.11	106.69	147.09
Scajaquada Creek	1674.2	100	FEMAEffRegPropFW	133.10	173.11	178.86	0.52	253.92	47.86	0.07	97.75	145.61
Scajaquada Creek	1674.2	100	FEMAEffRegExFW	133.10	173.11	178.88	0.52	254.95	47.86	0.07	97.75	145.61
Scajaquada Creek	1623.5	100	FEMAEffRegPropFW	133.10	172.81	178.83	0.90	159.70	35.90	0.13	99.54	135.44
Scajaquada Creek	1623.5	100	FEMAEffRegExFW	133.10	172.81	178.86	0.83	160.64	35.90	0.13	99.54	135.44
Scajaquada Creek	1559.5	100	FEMAEffRegPropFW	133.10	172.86	178.79	1.17	127.36	28.63	0.17	99.94	128.57
Scajaquada Creek	1559.5	100	FEMAEffRegExFW	133.10	172.86	178.83	1.04	128.30	28.63	0.16	99.94	128.57
Scajaquada Creek	1522.4	100	FEMAEffRegPropFW	133.10	173.03	178.82	0.78	235.43	89.64	0.11		
Scajaquada Creek	1522.4	100	FEMAEffRegExFW	133.10	173.03	178.84	0.77	237.74	89.77	0.11		
Scajaquada Creek	1488.5	100	FEMAEffRegPropFW	133.10	173.12	178.77	1.07	124.56	23.23	0.15	116.66	139.89
Scajaquada Creek	1488.5	100	FEMAEffRegExFW	133.10	173.12	178.79	1.06	125.01	23.23	0.15	116.66	139.89
Scajaquada Creek	1473.7	100	FEMAEffRegPropFW	133.10	173.37	178.78	1.05	167.96	65.35	0.16		
Scajaquada Creek	1473.7	100	FEMAEffRegExFW	133.10	173.37	178.79	1.03	168.84	65.68	0.16		
Scajaquada Creek	1463			Bridge								
Scajaquada Creek	1452.3	100	FEMAEffRegPropFW	133.10	173.37	178.75	1.04	180.18	77.16	0.16		
Scajaquada Creek	1452.3	100	FEMAEffRegExFW	133.10	173.37	178.79	1.02	183.17	77.54	0.16		
Scajaquada Creek	1438.1	100	FEMAEffRegPropFW	133.10	173.12	178.75	1.02	185.56	83.54	0.15		
Scajaquada Creek	1438.1	100	FEMAEffRegExFW	133.10	173.12	178.79	0.98	188.91	83.97	0.15		
Scajaquada Creek	1415.9	100	FEMAEffRegPropFW	133.10	173.06	178.63	1.66	80.19	15.15	0.23	149.20	164.35
Scajaquada Creek	1415.9	100	FEMAEffRegExFW	133.10	173.06	178.66	1.65	80.66	15.15	0.23	149.20	164.35
Scajaquada Creek	1381.8	100	FEMAEffRegPropFW	133.10	173.59	178.66	1.25	106.93	27.10	0.20	137.28	164.64
Scajaquada Creek	1381.8	100	FEMAEffRegExFW	133.10	173.59	178.66	1.25	106.93	27.10	0.20	137.28	164.64
Scajaquada Creek	1366.0			Bridge								

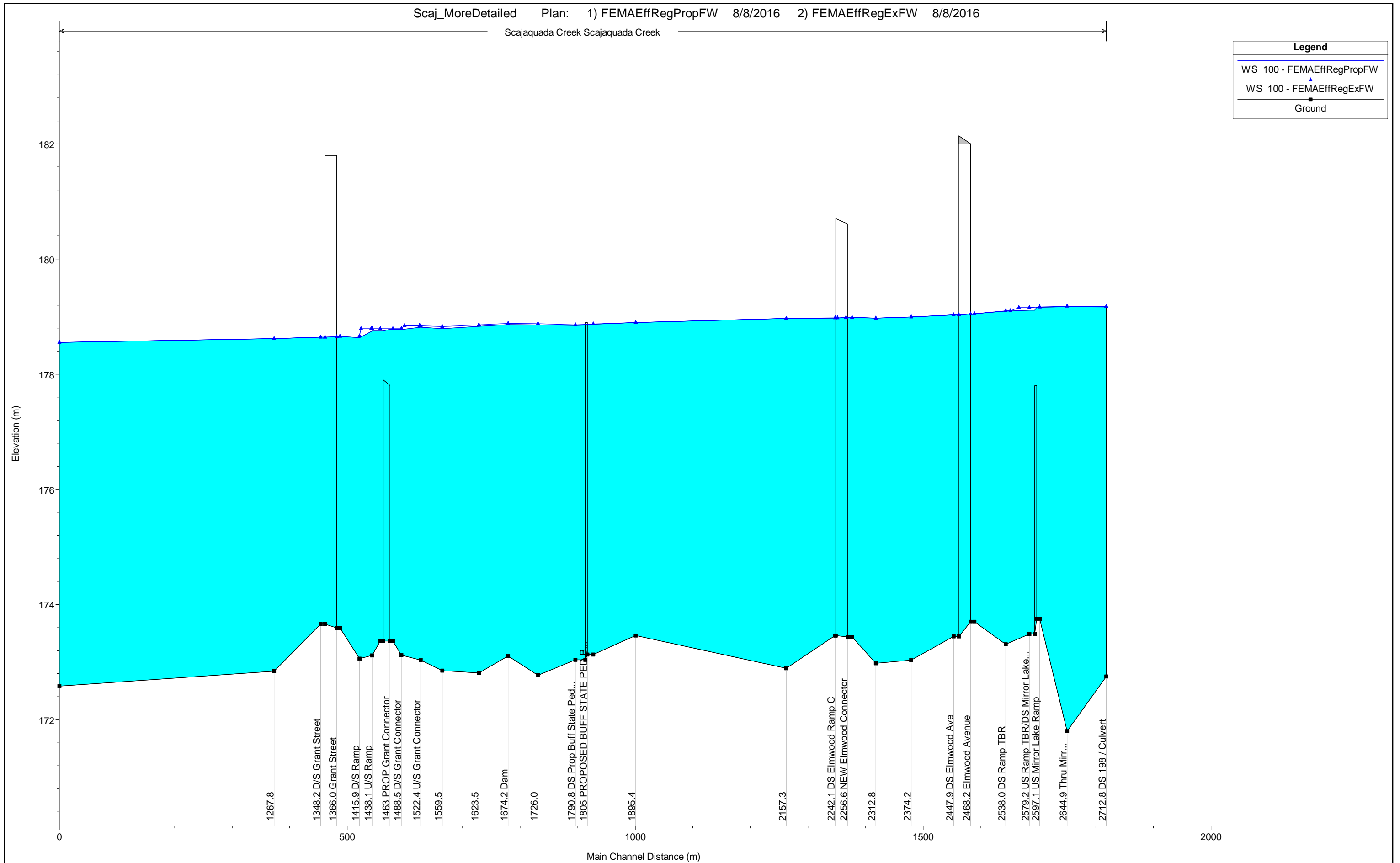
# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 100 (Continued)

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Enc Sta L (m)	Enc Sta R (m)
Scajaquada Creek	1348.2	100	FEMAEffRegPropFW	133.10	173.66	178.64	1.24	107.09	27.37	0.20	171.25	198.62
Scajaquada Creek	1348.2	100	FEMAEffRegExFW	133.10	173.66	178.64	1.24	107.09	27.37	0.20	171.25	198.62
Scajaquada Creek	1267.8	100	FEMAEffRegPropFW	133.10	172.84	178.62	1.20	110.68	25.29	0.18	124.96	150.25
Scajaquada Creek	1267.8	100	FEMAEffRegExFW	133.10	172.84	178.62	1.20	110.68	25.29	0.18	124.96	150.25
Scajaquada Creek	894.8	100	FEMAEffRegPropFW	133.10	172.58	178.55	1.04	127.94	26.95	0.15	112.32	139.27
Scajaquada Creek	894.8	100	FEMAEffRegExFW	133.10	172.58	178.55	1.04	127.94	26.95	0.15	112.32	139.27

Scaj\_MoreDetailed Plan: 1) FEMAeffRegPropFW 8/8/2016 2) FEMAeffRegExFW 8/8/2016

Scajaquada Creek Scajaquada Creek



# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 50

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Scajaquada Creek	2712.8	50	FEMAEffNormProp	116.10	172.75	178.18	175.67	178.18	0.000034	0.34	357.85	139.50	0.06
Scajaquada Creek	2712.8	50	FEMAEffNormEx	116.10	172.75	178.26	175.67	178.26	0.000032	0.33	368.95	148.28	0.06
Scajaquada Creek	2644.9	50	FEMAEffNormProp	116.10	171.80	178.18	175.07	178.18	0.000004	0.18	676.72	150.24	0.02
Scajaquada Creek	2644.9	50	FEMAEffNormEx	116.10	171.80	178.26	175.07	178.26	0.000004	0.17	688.55	159.34	0.02
Scajaquada Creek	2597.1	50	FEMAEffNormProp	116.10	173.75	178.17	174.97	178.18	0.000052	0.48	291.44	162.47	0.08
Scajaquada Creek	2597.1	50	FEMAEffNormEx	116.10	173.75	178.25	174.97	178.26	0.000048	0.47	304.12	164.30	0.08
Scajaquada Creek	2588			Bridge									
Scajaquada Creek	2579.2	50	FEMAEffNormProp	116.10	173.49	178.13	175.29	178.15	0.000113	0.73	230.53	162.71	0.12
Scajaquada Creek	2579.2	50	FEMAEffNormEx	116.10	173.49	178.24	175.29	178.26	0.000097	0.69	248.11	166.99	0.11
Scajaquada Creek	2538.0	50	FEMAEffNormProp	116.10	173.31	178.12	175.00	178.15	0.000111	0.74	173.01	57.05	0.12
Scajaquada Creek	2538.0	50	FEMAEffNormEx	116.10	173.31	178.22	175.00	178.24	0.000101	0.72	178.58	57.69	0.11
Scajaquada Creek	2483.8	50	FEMAEffNormProp	116.10	173.70	178.09	175.60	178.14	0.000251	0.99	147.15	69.83	0.17
Scajaquada Creek	2483.8	50	FEMAEffNormEx	116.10	173.70	178.19	175.60	178.23	0.000223	0.95	154.05	71.76	0.16
Scajaquada Creek	2468.2			Bridge									
Scajaquada Creek	2447.9	50	FEMAEffNormProp	116.10	173.45	178.08		178.12	0.000277	1.04	145.30	72.60	0.18
Scajaquada Creek	2447.9	50	FEMAEffNormEx	116.10	173.45	178.18		178.22	0.000244	0.99	152.56	73.06	0.17
Scajaquada Creek	2374.2	50	FEMAEffNormProp	116.10	173.04	178.04		178.10	0.000296	1.15	135.55	69.84	0.19
Scajaquada Creek	2374.2	50	FEMAEffNormEx	116.10	173.04	178.14		178.20	0.000264	1.10	142.86	72.15	0.18
Scajaquada Creek	2312.8	50	FEMAEffNormProp	116.10	172.98	178.02		178.08	0.000288	1.15	144.25	90.41	0.19
Scajaquada Creek	2312.8	50	FEMAEffNormEx	116.10	172.98	178.13		178.18	0.000252	1.10	153.98	92.96	0.18
Scajaquada Creek	2271.6	50	FEMAEffNormProp	116.10	173.44	178.01	175.42	178.07	0.000335	1.09	107.59	39.00	0.20
Scajaquada Creek	2271.6	50	FEMAEffNormEx	116.10	173.44	178.11	175.42	178.17	0.000300	1.06	111.71	39.46	0.19
Scajaquada Creek	2256.6			Bridge									
Scajaquada Creek	2242.1	50	FEMAEffNormProp	116.10	173.46	177.99	175.42	178.06	0.000344	1.11	106.18	37.84	0.20
Scajaquada Creek	2242.1	50	FEMAEffNormEx	116.10	173.46	178.10	175.42	178.16	0.000308	1.07	110.17	38.05	0.19
Scajaquada Creek	2157.3	50	FEMAEffNormProp	116.10	172.89	177.98	175.19	178.02	0.000188	0.91	131.29	40.59	0.15
Scajaquada Creek	2157.3	50	FEMAEffNormEx	116.10	172.89	178.09	175.19	178.13	0.000170	0.88	135.64	41.03	0.14
Scajaquada Creek	1895.4	50	FEMAEffNormProp	116.10	173.46	177.86	175.65	177.94	0.000519	1.27	92.12	34.63	0.24
Scajaquada Creek	1895.4	50	FEMAEffNormEx	116.10	173.46	177.98	175.65	178.06	0.000451	1.21	96.28	35.25	0.23
Scajaquada Creek	1821.8	50	FEMAEffNormProp	116.10	173.13	177.82	175.54	177.91	0.000454	1.31	90.93	30.75	0.23
Scajaquada Creek	1821.8	50	FEMAEffNormEx	116.10	173.13	177.95	175.54	178.02	0.000407	1.25	94.76	31.18	0.22

# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 50 (Continued)

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Scajaquada Creek	1805			Bridge									
Scajaquada Creek	1790.8	50	FEMAEffNormProp	116.10	173.04	177.80	175.45	177.89	0.000547	1.34	86.60	28.78	0.25
Scajaquada Creek	1790.8	50	FEMAEffNormEx	116.10	173.04	177.93	175.45	178.01	0.000442	1.30	90.26	29.29	0.23
Scajaquada Creek	1726.0	50	FEMAEffNormProp	116.10	172.77	177.81	174.94	177.84	0.000197	0.87	134.15	40.64	0.15
Scajaquada Creek	1726.0	50	FEMAEffNormEx	116.10	172.77	177.94	174.94	177.98	0.000171	0.83	139.79	41.09	0.14
Scajaquada Creek	1674.2	50	FEMAEffNormProp	116.10	173.11	177.82	174.25	177.83	0.000062	0.57	210.30	56.72	0.09
Scajaquada Creek	1674.2	50	FEMAEffNormEx	116.10	173.11	177.95	174.25	177.97	0.000056	0.55	218.24	59.01	0.08
Scajaquada Creek	1623.5	50	FEMAEffNormProp	116.10	172.81	177.77	174.90	177.82	0.000222	1.00	127.69	53.73	0.16
Scajaquada Creek	1623.5	50	FEMAEffNormEx	116.10	172.81	177.92	174.90	177.96	0.000195	0.89	143.37	72.63	0.15
Scajaquada Creek	1559.5	50	FEMAEffNormProp	116.10	172.86	177.73	175.09	177.80	0.000323	1.26	118.22	68.73	0.20
Scajaquada Creek	1559.5	50	FEMAEffNormEx	116.10	172.86	177.89	175.09	177.94	0.000284	1.07	129.22	69.40	0.18
Scajaquada Creek	1522.4	50	FEMAEffNormProp	116.10	173.03	177.74	174.66	177.79	0.000244	1.01	141.73	84.20	0.15
Scajaquada Creek	1522.4	50	FEMAEffNormEx	116.10	173.03	177.89	174.66	177.93	0.000212	0.95	154.63	85.01	0.14
Scajaquada Creek	1488.5	50	FEMAEffNormProp	116.10	173.12	177.71	174.73	177.78	0.000317	1.16	103.02	35.94	0.18
Scajaquada Creek	1488.5	50	FEMAEffNormEx	116.10	173.12	177.80	174.73	177.87	0.000293	1.13	106.54	37.19	0.17
Scajaquada Creek	1473.7	50	FEMAEffNormProp	116.10	173.37	177.67	175.60	177.77	0.000590	1.43	99.85	59.13	0.26
Scajaquada Creek	1473.7	50	FEMAEffNormEx	116.10	173.37	177.76	175.60	177.85	0.000531	1.36	105.36	59.46	0.24
Scajaquada Creek	1463			Bridge									
Scajaquada Creek	1452.3	50	FEMAEffNormProp	116.10	173.37	177.61	175.60	177.72	0.000615	1.47	98.90	65.36	0.26
Scajaquada Creek	1452.3	50	FEMAEffNormEx	116.10	173.37	177.75	175.61	177.84	0.000517	1.38	107.92	66.68	0.24
Scajaquada Creek	1438.1	50	FEMAEffNormProp	116.10	173.12	177.60	175.10	177.71	0.000576	1.46	84.33	37.77	0.24
Scajaquada Creek	1438.1	50	FEMAEffNormEx	116.10	173.12	177.75	175.09	177.83	0.000478	1.31	108.36	72.39	0.22
Scajaquada Creek	1415.9	50	FEMAEffNormProp	116.10	173.06	177.51	175.08	177.68	0.001047	1.84	63.97	23.49	0.29
Scajaquada Creek	1415.9	50	FEMAEffNormEx	116.10	173.06	177.54	175.08	177.71	0.001024	1.82	64.60	24.61	0.28
Scajaquada Creek	1381.8	50	FEMAEffNormProp	116.10	173.59	177.52	175.61	177.64	0.000764	1.53	76.19	29.25	0.29
Scajaquada Creek	1381.8	50	FEMAEffNormEx	116.10	173.59	177.52	175.61	177.64	0.000764	1.53	76.19	29.25	0.29
Scajaquada Creek	1366.0			Bridge									
Scajaquada Creek	1348.2	50	FEMAEffNormProp	116.10	173.66	177.47	175.66	177.60	0.000813	1.54	75.64	32.80	0.30
Scajaquada Creek	1348.2	50	FEMAEffNormEx	116.10	173.66	177.47	175.66	177.60	0.000813	1.54	75.64	32.80	0.30
Scajaquada Creek	1267.8	50	FEMAEffNormProp	116.10	172.84	177.43	175.12	177.53	0.000598	1.44	81.23	27.82	0.26

# Effective FEMA BFEs Existing vs. Proposed

HEC-RAS River: Scajaquada Creek Reach: Scajaquada Creek Profile: 50 (Continued)

Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Scajaquada Creek	1267.8	50	FEMAEffNormEx	116.10	172.84	177.43	175.12	177.53	0.000598	1.44	81.23	27.82	0.26
Scajaquada Creek	894.8	50	FEMAEffNormProp	116.10	172.58	177.27	174.66	177.34	0.000400	1.24	94.04	28.80	0.21
Scajaquada Creek	894.8	50	FEMAEffNormEx	116.10	172.58	177.27	174.66	177.34	0.000400	1.24	94.04	28.80	0.21

